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LONDON: PUBLISHING OFFICE, 4, LUDGATE HILL, E.C. 4 SUBSCRIPTION per annum, Postage inclusive, in Great Britain, £1 1s. 8d. Canada, £1 3s. 10d. (£5.30); to all other countries, 30s.—NEW YORK: D. VAN NOSTRAND CO., 25, Park Place, New York City. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. PARIS: BOYVEAU & CHEVILLET, Librairie, Etrangère, 22, Rue de la Banque.
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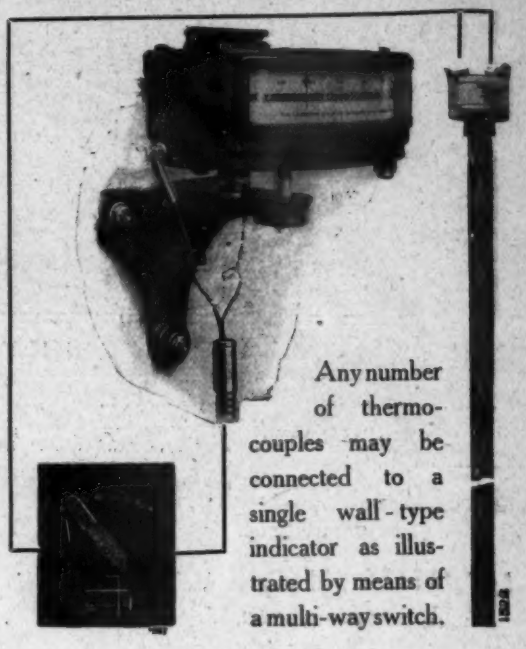

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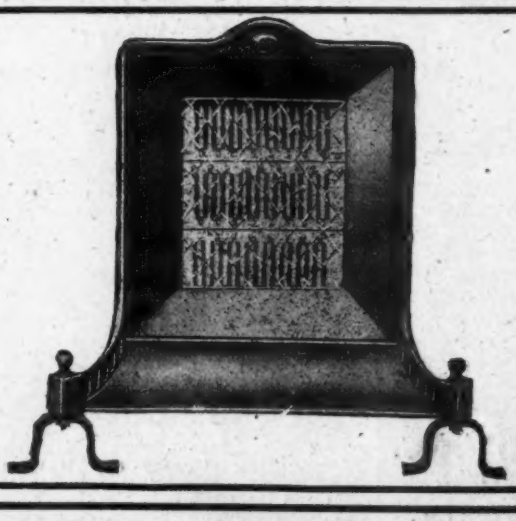

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ELECTRICAL REVIEW.

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The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 6d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson, & Co., Gresham Street.

AUCKLAND N.Z.: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31A, Strand Arcade, Queen Street.

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ROME: Loescher & Co., Corso Umberto 1° 307.

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TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.

WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

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AFTER THREE YEARS.

IT may not seem that the political changes that are now in progress in Germany are a matter which directly concern us in these pages, yet we cannot but regard them as important milestones indicating that we are on the way toward the end, and that end assuredly is a matter of the deepest concern for us all. After three years of terrible war, the originators of it may banish their Bethmann-Hollweg because he is not regarded as a fit man to negotiate Peace, but they cannot escape the haunting foot-tread of Nemesis. With all conceivable forms of ingenuity they may try to dodge it, but fate follows relentlessly in the wake of those who have shocked all outside Civilisation with deeds as foul as they have been dishonourable. Many parties seem to be finding their voice to-day, but in the main they are uttering two distinct cries. Peace without Indemnities is the boon clamoured for, and the concession condescendingly approved, by those whom sheer necessity has driven to want Peace speedily at all costs. Peace *with* Indemnities is the demand of those who, looking ahead, see Germany ruined for many a year unless indemnities can be secured to strengthen credit, so that industry may be able to purchase raw materials abroad and re-establish the economic and industrial position which the folly of Prussian ambition has broken up.

We are not suggesting that the end is near—who has any means of knowing?—the position is very involved, and fate only knows the hour of the final issue; but if recent events have brought the only end there can be appreciably nearer than it seemed a few weeks ago, they have also brought nearer for all the nations that period of very serious problems which, as the Chancellor of the Exchequer told the House of Commons, would be more difficult to handle than all the problems of even the war itself. The apostle of gloom is of all men the most unwelcome and the most unhelpful, but the optimist who tries to humour us into the belief that all will be well when the war is ended is a dangerous and an undesirable companion, for the plainest facts of the situation should compel us all to approach the times that lie ahead with the utmost seriousness and foresight. It is not only in the countries that will lose the war that there will be unparalleled difficulties of various kinds to be faced; the nations that win, and the nations that are neutral, will also have their period of anxiety and stress and their own peculiar problems to solve. Nemesis will inevitably punish our enemies, and they will settle between themselves, perhaps quarrel over, their own difficulties. But the effects of colossal expenditures and the disorganisation of three years will be felt by the victors, too, though the problems of the Allies will be different from those of their enemies. There will be a freer inter-trading and a strong bond of sympathy between them, while many markets of the world will be wider open to them than ever before if they are in a position to take advantage of the situation, but the German business man has to learn that he has, through his Government, set practically all the world by the ears, and will not easily regain the prestige of pre-war days. We shall inevitably witness some hard striving for terms which will open the way for economic security and the resumption of former activities. At present the industrial magnates of Berlin and their satellites may recognise

the economic menace of the future, but apparently the people are still blinded to their future hardships unless the return of the Stockholm visitors has adequately informed them of the feelings of revulsion of the whole world against them.

So far as the British Empire is concerned, we have been discussing our own after-the-war trade problems ever since the outbreak of war. Great things have been done here, and in the Colonies, which will prevent our falling back into positions of apathy and unpreparedness. Much of our old susceptibility to attack will no longer remain. But the changing phases of the whole war situation throughout the world have necessarily interfered with the elaboration of definite policies respecting trade. Our Government-appointed committees have made their investigations, but apparently, in the opinion of the Government the time has not yet arrived when any concrete propositions can be based upon these and announced. Our relations with our Allies naturally greatly affect these matters, and the conclusions of the Paris Economic Conference were arrived at and adopted before America had brought her vast resources definitely on to our side. We may reasonably anticipate that new economic and trading agreements will be entered into in many directions, and it may well happen that after the war a near approach to commercial co-operation will take place among some of the great peoples who in the past have been in competition with each other. There is the possibility of closer working arrangements being introduced between parts of the British Empire and the United States, and the latter is strengthening some of her concerns so that they may be in a position to defeat any efforts that German trust organisations may be able to put forth abroad.

Before the end, the situation may yet undergo other changes, for we must recognise that most things are still in the melting-pot. The German mind is a thing fearfully and wonderfully made. Looked at from the point of view of the Allies, the economic position can only become worse and worse for her people the longer the war is continued if the Allies remain solid, with the substantial reinforcement of the United States. But the German people cannot speedily throw down the Prussian forces that have brought them face to face with ruin; if they fully knew the temper of the world that is against them they probably would do so in order to save some measure of their former international trade for the millions of workers. Almost inevitably, as it seems, they must yet curse the day when they were first led to bow down before the clay-footed idol of Prussian ambition.

We may leave our enemies to work out their own salvation. Necessity requires that we should centre our attention and effort on our own measures of preparation for the future. A speech recently delivered in the Canadian Senate, by the Hon. Frederic Nicholls, on "The Conservation and Extension of Canadian Trade" shows that anxiety there has led to proposals for immediate preparations to be set on foot for the after-the war period of disorganisation. "When the war ends," said Mr. Nicholls, "we run great danger of a panic through disorganised trade conditions unless the Government lends a helping hand." He calls for constructive statesmanship and the risking of millions of State funds in the development of trade.

"Constructive statesmanship," based upon a full appreciation of all the difficulties, will be what all our Colonies and the Allied nations will need in the momentous years to come. Heaven grant it may not fail us!

We now have a "Minister in Charge of Reconstruction" in the person of Dr. Addison, whose experience of practical life at the Ministry of Munitions should render him better fitted for the introduction of workable measures for Social Reform. From him and from the Ministry of Labour we shall require much "Constructive Statesmanship."

The Electric Power Supply Committee.

Interest in the constitution and intentions of the Board of Trade Departmental Committee on Electric Power Supply continues unabated. As reported in our "Notes" columns to-day, the representation of various interests on that body has been the subject of questions in the House of Commons; not only the municipal supply authorities, but also the provincial companies and the metropolitan undertakings are endeavouring to secure a voice in the deliberations of the Committee. Sir Albert Stanley considers that the Committee as now constituted is sufficiently representative of all parties, and is disinclined to make further additions to its membership.

The demand for direct representation of particular interests on deliberative bodies is a familiar feature of our social system; but we are not at all sure that the principle is a good one. Allowance must be made, no doubt, for personal predilections; a man immersed in a certain mode of thought must necessarily arrive at conclusions in harmony with his experience, and perfect freedom from bias cannot be attained by him. Hence, if members of one section of a profession or trade are appointed on a committee, it is not only fair but necessary that members of other sections, whose interests diverge from those of the former, should also be nominated. But it is the duty of each member of the Committee to endeavour to do justice to all sections, not to further the interests of any one section, and for this reason it would be far preferable that the Committee should be constituted as a judicial body with no sectional interests to serve at all. The idea may be Utopian, but if it could be carried out, it would make for efficiency and justice.

Electric Furnaces.

One of the most noteworthy of the many advances in electrical applications which the war has directly brought about in this country is the remarkable popularity which the electric steel furnace has acquired in a short period. It is true that before the war electric furnaces had been installed here and there—mainly in Sheffield—but progress was slow, and manufacturers regarded the new practice as experimental in character, while the irregular nature of the load largely discounted its obvious advantages in the eyes of the central-station manager.

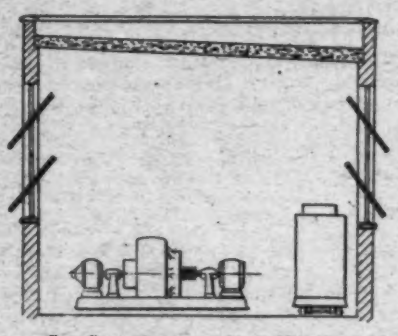
However, war conditions brought the matter to a head in a hurry; the urgent necessity of increased supplies of special alloy steels of the very highest quality, and of utilising all scrap to the best advantage, compelled steel manufacturers to make investigations, with the result so often experienced in connection with the applications of electricity—they found that not only was the output increased and the quality of the product vastly improved by the electrical process, but also the cost of labour was greatly reduced, and the cost of energy was quite reasonable. Moreover, the supply authorities under the new conditions were more solicitous for the fulfilment of the manufacturers' requirements than for the uniformity of their voltage records, and did all in their power to ensure an ample supply of electrical energy. Consequently, the electric furnace has scored a signal triumph, and has proved of inestimable value to the nation. It is for this reason that we have published all the information regarding it that has been available, for the assistance of makers and users of steel furnaces. When the war is over we hope to place before our readers particulars regarding developments in this connection, such as the provision of generating plant, &c., at certain centres, that will astonish them.

THE THEORETICAL CONSIDERATION OF THE VENTILATION OF SUB-STATIONS AND TRANSFORMER HOUSES.

By T. H. WOOD.

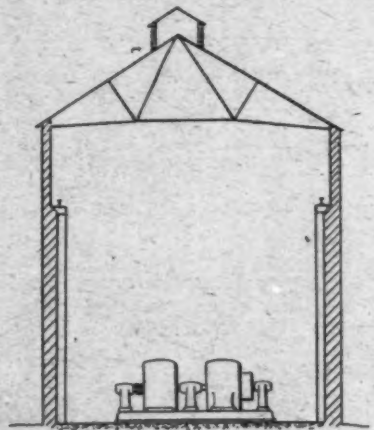
Although this subject is so important a factor in the design of sub-stations, it does not always receive the consideration which it deserves, especially as the results obtained by theory agree so well with the conditions found in well-designed sub-stations.

Between the two modes of ventilation, mechanical and natural, it is impossible to fix any hard and fast rule, as each has its own particular advantages, and local conditions must always be the deciding factor. Natural ventilation has the great advantage of utilising the heat derived from the energy losses of the plant, so that the running cost is nil, and the initial cost of the louvre ventilators is not



Section of Sub-Station with Side Windows (k = 0·5).

excessive. A common form of construction is to have them about 2 ft. high, running the length of the roof. The disadvantage of the louvre type is that it is not easy to vary the ventilating area, so that on light load in winter time the sub-station gets very cold. This can be remedied to a certain extent by employing a double row of windows, made to open and close as desired, and arranged in the form



Section of Sub-Station with Lantern (k = 0·6).

of a roof lantern, thereby serving the double purpose of lighting the centre of the building and providing a means of ventilation which can be regulated.

Mechanical ventilation is usually carried out by means of a propeller fan fitted in a circular hole near the roof, the chief advantage being the much reduced ventilating area required; and if it is fitted in the gable end, it can often be made to assist in the architectural design of the building, but one must not overlook the running cost.

In the following calculations, only the total plant which is likely to be running at one time and at its rated capacity is taken into account. The converting machinery is only designed for overloads over a certain period of time; when the machinery is taking an overload, the total extra heat given out would probably only balance the heat absorbed in heating the plant and room, &c., through the 20° F. rise allowed, and, for practical reasons, has not been included in the formula.

The power lost in the whole plant, transformers and converters combined, will be converted into heat, so that it is an easy matter to find the exact amount of heat generated in the station.

The power loss is (100 − eff. per cent.) × size of plant in kw. ÷ 100. This will be denoted by E kw.

To convert E kw into British thermal units per minute,

$$\text{E } kw \times 1{\cdot}34 \times 33{,}000/778 = 56{\cdot}8 \text{ E } kw = \text{B.TH.U. per minute.}$$

As the specific heat of air is 0·24, one B.TH.U. will raise $1/0{\cdot}24 = 4{\cdot}2$ lb. of air through 1° F. at constant pressure, and at 70° F. 4·2 lb. of air occupies 55 cb. ft.

The total number of cubic feet of air per minute raised through (T − t) degrees F., where T is the inside temperature and t the outside temperature of a building, is given by—

$$C = 56{\cdot}8 \text{ E } kw \times 55/(T - t) \quad \ldots \quad \ldots \quad (1)$$

and this quantity of air will have to pass through the station every minute.

It will now be necessary to find the velocity at which the air will pass through the ventilators due to reduction in specific gravity; this will depend upon the height of the building and the difference in temperature between the inside and outside air, and is given theoretically by—

$$V = 480 \sqrt{[h\,(T - t)/(t + 460)]} \quad \ldots \quad (2)$$

where V = velocity of air in feet per minute, and h = height of sub-station from centre of bearings to under side of louvres.

In actual practice this will vary according to the design of the station, and the above should be multiplied by a constant k varying from 0·4 to 0·6, the constant approaching the higher value the nearer the station approaches a straight shaft. The values given below have been found suitable for the particular types of buildings concerned (see figures).

The area of the ventilators will be:—

Cubic feet of air to be removed per minute ÷ velocity of air through ventilators in feet per minute, and substituting from equations (1) and (2)—

$$A = 56{\cdot}8 \text{ E } kw \times 55\,/(T - t) \div k\,480 \sqrt{[h(T - t)/(t + 460)]}.$$

This can be greatly simplified if we take the average temperature in England at 62° F. and the permissible rise at 20° F.

The equation then becomes—

$$A = 56{\cdot}8 \text{ E } kw \times 55/20 \div k\,480 \sqrt{[h \times 20/522]}$$
$$= 156{\cdot}2 \text{ E } kw/k\,480 \sqrt{[{\cdot}0383\,h]}. \quad \ldots \quad \ldots \quad (3)$$

Where E kw = loss of power in kw.; k a constant depending upon the design of the station and varying from ·6 to ·4; and h height of louvre ventilators from centre of machine bearings or half height of transformers.

As a practical example, let us take the case of a 1,000-kw. rotary converter with transformers, the combined efficiency being 92 per cent., height of sub-station 25 ft., taking k = ·5.

$$\text{Area} = 156{\cdot}2 \text{ E } kw/k\,480 \sqrt{[{\cdot}0383\,h]}$$
$$= 12{,}496/235 = 54 \text{ sq. ft.}$$

One must bear in mind the difference between the ventilation of a sub-station and that of a public building; in the former case, the main object is to keep the temperature within certain limits, and not, as in the case of a public building, to change the air for sanitary purposes. Therefore, the cooling effect of the walls, roof, and windows tends to reduce the ventilating area required in the case of a sub-station, but in the case of a public building this would have the reverse effect if natural ventilation were employed. A better result can, therefore, be obtained by taking into account this loss by radiation, and the following gives the B.TH.U. loss by radiation per sq. ft. per hour per deg. F. difference between the inside and outside air temperatures:—

Brick wall. Thickness ...	9 in.	14 in.	18 in.	22½ in.
B.TH.U. per hour	·45	·3	·25	·21
1 sq. ft. of window	1 B.TH.U.			
1 „ „ skylight	1·03 „			
Outside door	0·41 „			
Slates	1·04 „			
1¼ in. boards in roof	0·38 „			

As the temperature rise in the station is fixed at 20° F., the total loss of heat in B.TH.U. per minute is given by—

$$\text{Loss B.TH.U. per minute} = (\text{area of walls} \times k_1 + \text{area of windows} \times k_1 + \text{area of skylight} \times k_1 + \text{area of roof} \times k_1) \times 20 \div 60 = \tfrac{1}{3} \Sigma (\text{areas} \times k_1),$$

and this quantity will have to be subtracted from the heat generated in the station, and modifies formula (1)—

$$[56{\cdot}8 \text{ E } kw - \tfrac{1}{3} \Sigma (\text{areas} \times k_1)] \times 55 \div 20 \quad \ldots \quad (4)$$

This gives the quantity in cb. ft. of air to be changed after allowing for loss in radiation through the walls, roof, &c., and the modified ventilating area will be from equations (4) and (2)—

$$[56{\cdot}8 \text{ E } kw - \tfrac{1}{3} \Sigma (\text{areas} \times k_1)] \times 2{\cdot}75/k \; 480 \times \sqrt{(\cdot 0383\, h)}. \quad \ldots \quad (5)$$

Working out the previous example of a rotary converter of 1,000 KW. with transformers, the combined efficiency being 92 per cent., height of sub-station 25 ft., again taking $k = \cdot 5$, the area of 14-in. brickwork = 1,488 sq. ft., area of glass in roof 216 sq. ft., area of slates on 1¼-in. boards 360 sq. ft. —

$$[56{\cdot}8 \times 80 - \tfrac{1}{3} (1{,}488 \times {\cdot}3 + 216 \times 1{\cdot}03 + 360 \times {\cdot}38)] \; 2{\cdot}75/{\cdot}5 \times 480 \times \sqrt{({\cdot}0383 \times 25)} = 50 \text{ sq. ft.}$$

By taking into account the loss of heat by radiation, the ventilating area has been reduced 4 sq. ft. for a 1,000-KW. machine.

Mechanical Ventilation.—If the ventilation is to be done by fan the quantity of air in cubic feet per minute to be moved will, of course, remain the same as with natural ventilation, and is obtained from equation (4). If a propeller fan is used the diameter can best be obtained from the maker's catalogue, or approximately from the formula—

$$\text{D} = \sqrt[3]{[\text{C}/0{\cdot}75 \text{ N}]},$$

where D = diameter of fan in feet; N = number of revs. per minute; and C = cubic feet of air moved.

By substituting equation (4) in place of C in the above expression—

$$\text{D} = \sqrt[3]{[\{56{\cdot}8 \text{ E } kw - \tfrac{1}{3} \Sigma (\text{areas} \times k_1)\} 2{\cdot}75/{\cdot}75 \text{ N}]}. \quad (6)$$

Working out the diameter of fan required for a station exactly as in the previous example, and taking revs. of fan per minute as 400—

$$\text{D} = \sqrt[3]{[(4{,}544 - 272)\; 2{\cdot}75/{\cdot}75 \times 400]} = 3 \text{ ft. } 4 \text{ in. diameter.}$$

Therefore, by using mechanical ventilation, the area has been reduced by 50 − 8·72 = about 41 sq. ft. for a 1,000-KW. set.

Finally, let us consider two cases which occurred in actual practice: the first, a sub-station lay-out of two rotary converters with transformers, each 1,500 KW. rated capacity and 92 per cent. efficiency, one of which only was to be used, the other kept as stand-by. The overall dimensions of the building were 35 ft. × 50 ft. × 23 ft. high to eaves and 32 ft. to under-side of ventilators. The radiation areas were 14-in. walls, 4,120 sq. ft., roof slates on boards, 1,250 sq. ft., and glass in skylight 600 sq. ft. In this station the ventilating area was 64 sq. ft., and the temperature rise 15° F. Let us see how this compares with the formula:—

$$\text{Area} = [56{\cdot}8 \times 120 - \tfrac{1}{3} (4{,}120 \times {\cdot}3 + 1{,}250 \times {\cdot}38 + 600 \times 1{\cdot}03)] \; 2{\cdot}75/{\cdot}6 \times 480 \times \sqrt{({\cdot}0383 \times 32)} = (6{,}816 - 776) \times 2{\cdot}75/288 \times 1{\cdot}1 = 16{,}610/317 = 52{\cdot}5 \text{ sq. ft.}$$

And as the formula allows for a 20° rise, I think the results were very satisfactory.

The second case, one that was much more suitable for comparison, the station being full of plant under a fairly steady load, was a transformer house with three 500-K.V.A. transformers under full load, the efficiency being 98 per cent. The ventilation was by a fan 2 ft. in diameter, making 600 R.P.M., and the temperature rise about 20° F. The area of 14-in. brickwork was 594 sq. ft., 9-in. brickwork 774 sq. ft., iron doors 242 sq. ft., and roof (slates only) 364 sq. ft.

The diameter of fan required as obtained from the formula is—

$$\text{D} = \sqrt[3]{[\{56{\cdot}8 \times 30 + \tfrac{1}{3} (594 \times {\cdot}3 + 774 \times {\cdot}45 + 242 \times 1 + 364 \times 1)\} \times 2{\cdot}75/{\cdot}75 \times 600]} = \sqrt[3]{[(1{,}704 - 377) \times 2{\cdot}75/450]} = \sqrt[3]{8} = 2 \text{ ft. diameter.}$$

The formula in this case agrees exactly with the results found in practice.

WESTINGHOUSE TURBO-ALTERNATORS.

THE constant progress that is taking place in the evolution of the turbo-generator causes special interest to attach to two brochures which have been issued by the British Westinghouse Electric and Manufacturing Co., Ltd., describing respectively their steam turbines—high-pressure, low-pressure, mixed, and back-pressure—and their alternators for coupling to them. At an early stage, when licensees of the Parsons type of turbine, the Westinghouse Companies saw the desirability of combining the advantages of the impulse type with those of the reaction type that they were building, and substituted for the high-pressure stages of the Parsons turbine a velocity-compounded element on the impulse principle, thus producing the "disk and drum" type of turbine which has become so popular. Later, after a thorough investigation of the systems available, they took out licences to manufac-

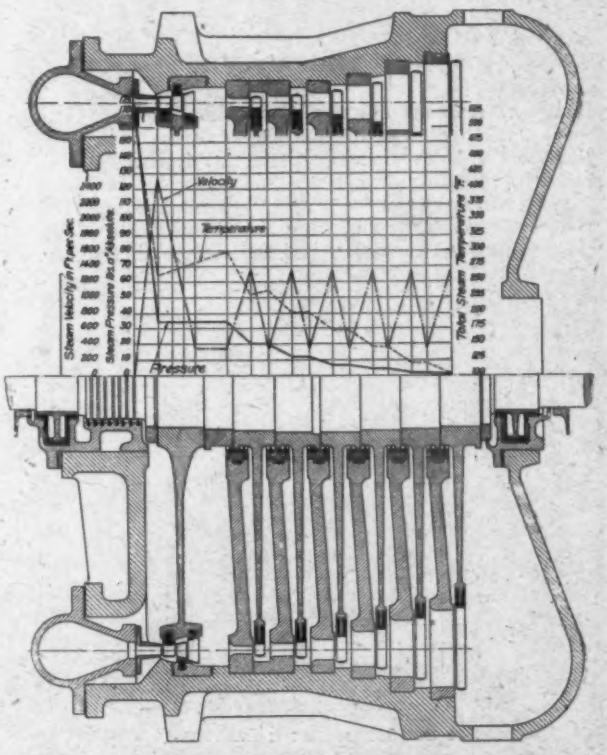


FIG. 1.—DIAGRAMMATIC SECTION OF WESTINGHOUSE-RATEAU HIGH-PRESSURE TURBINE.

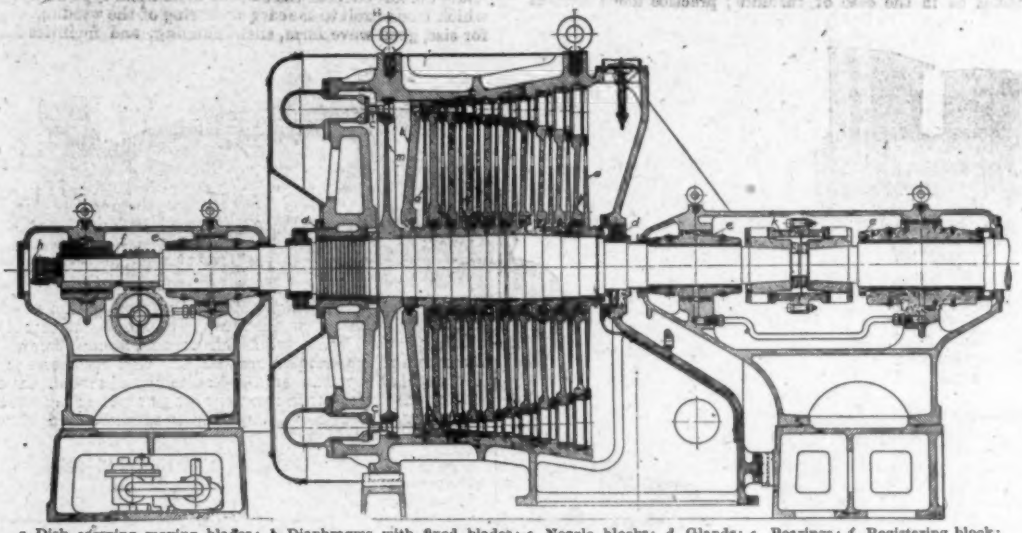
ture under the patents of Prof. Rateau, of Paris, and eventually adopted the impulse principle for their standard machines.

It was, however, considered desirable to employ a velocity wheel at the high-pressure end instead of following the pure Rateau system throughout, as the latter would give a pressure inside the casing, with steam at 175 lb. per sq. in. absolute (12·3 kg./cm.²) superheated to 525° F. (274° C.), of 85 lb. per sq. in. (6 kg./cm.²) at 415° F. (213° C.), whereas the modified design, as shown in the accompanying section, fig. 1, enables the pressure in the casing to be reduced to 35 lb. per sq. in. abs. (2·5 kg./cm.²) and the temperature to 265° F. (130° C.), thus lightening the construction and avoiding distortion of the cylinder; at the same time with the velocity wheel the machine is shortened between the bearings, the shaft is stiffer, and the critical speed is raised. While the drum turbine is cheaper to construct, the disk type lends itself to

more accurate calculation of the stresses. Each wheel can be balanced separately on the shaft, and thus the whole spindle is balanced throughout. The drum construction may be balanced statically, but be considerably out of running balance.

For these and other reasons, the British Westinghouse Co. adopted as their standard the pure impulse turbine, having a velocity wheel at the high-pressure end and the Rateau impulse wheels for the succeeding stages.

The steam first expands through nozzles in which its potential energy is partly converted into kinetic energy, acquiring sufficient velocity to do work efficiently on two rows of moving blades, the intermediate fixed blades being merely deflecting or guide blades. After the steam leaves the velocity wheel its expansion is continued in single stages until the exhaust pressure is reached, each stage consisting of a diaphragm fixed in the cylinder and a moving wheel on the shaft; the velocity acquired by the steam in expanding through the diaphragm nozzles is completely used up on the moving wheel. A section of the complete turbine is given in fig. 2.



a, Disk carrying moving blades; *b*, Diaphragms with fixed blades; *c*, Nozzle blocks; *d*, Glands; *e*, Bearings; *f*, Registering block; *g*, Safety governor; *h*, Coupling.

FIG. 2.—LONGITUDINAL SECTION THROUGH WESTINGHOUSE-RATEAU H.P. IMPULSE TURBINE.

There are usually three nozzle blocks, the number in use depending upon the load. The main governor is driven by a worm on the shaft between the main bearing and the registering or thrust block, the duty of which is not to resist end thrust, as there is none, but to maintain the shaft in its correct position with regard to the cylinder. The oil pump is driven from the main governor shaft. It will be noticed that one end of the cylinder is fixed to the bedplate, while the other is free to slide on a guide to allow of expansion; the tranverse expansion of the cylinder is likewise provided for. The cylinder is of special cast-iron, strengthened with ribs, but the high-pressure nozzles are of wrought steel, machined all over. The diaphragms are cast in halves, as shown in fig. 3, with spigot and socket joints to prevent leakage of steam from one side to the other, and the respective halves in the upper and lower portions of the cylinder are not disturbed when the machine is opened; the outer periphery of each diaphragm fits in a groove in the cylinder, and the inner periphery is provided with special glands, which almost touch the shaft. The guide blades are of special steel, cast into the cast-iron diaphragms, or segmentally fixed to the diaphragms when cast-steel is used for the latter. The advantage of split diaphragms, with regard to accessibility, as compared with the practice of threading one-piece diaphragms on the shaft alternately with the blade wheels, is self-evident.

FIG. 3.—SPLIT DIAPHRAGM.

The blade wheels are of the finest wrought steel, of taper section, and are machined all over; large holes are provided to ensure that the pressure on both sides shall always be the same.

The blades are machined out of the solid bar to a curve defined by a former fixed on the machine, so that they are all exactly alike in shape and weight. The methods adopted for attaching them to the wheels are shown in figs. 5 and 6; the former applies to the velocity wheel, the blades being dovetailed into and accurately fitting a T-slot, while the "straddle" type is used for the disks, to which the blades are attached with rivets in double shear. The wheels are forced upon the shaft and driven by feather keys, the last wheel being fixed with a nut. The axial clearance between the blades and stationary parts varies from $\frac{1}{8}$ to $\frac{3}{16}$ in. (3 to 5 mm.), and the radial clearance between the tips of the revolving blades and the cylinder is never less than $\frac{1}{4}$ in. (6 mm.).

The shaft is of steel, stepped in diameter for each wheel, and is fitted with the Westinghouse water gland at each end, as well as with a labyrinth gland at the high-pressure end (where the pressure is about 20 lb. by gauge at full load); between the two glands at the high-pressure end is a connection to the exhaust space, so that both water glands are under identical conditions. They are absolutely air-tight, keep the bearings cool, prevent escape of steam into the engine room, and are perfectly self-adjusting under all conditions of load and vacuum.

The governor valve and overload valve are operated by an oil relay. The valves are of the balanced double-seated type, with self-aligning plates. The governor is of simple design, with provision for varying the speed whilst running, and an overspeed safety device is fitted on the end of the shaft, which trips the stop valve in case of excess of speed by releasing the oil pressure in the relay cylinder.

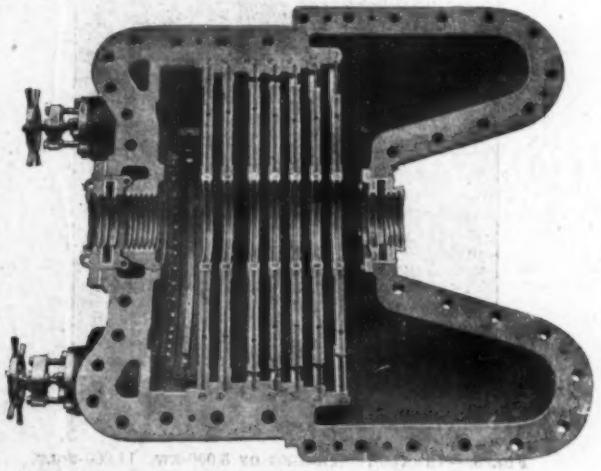


FIG. 4.—DIAPHRAGMS IN POSITION IN HALF-CYLINDER.

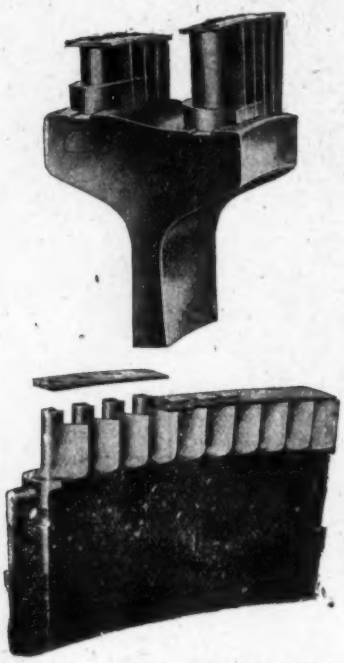
The bearings are usually of cast-iron lined with white metal, and are provided with liners allowing the main spindle to be adjusted in any direction. A rigid shaft coupling is used for high-speed turbines, and a flexible type for low speeds, the latter consisting of two serrated heads engaging with a cylindrical sleeve, which can be slid to either side on removing a cover plate, so that

either of the revolving elements can be removed without interfering with the other.

Exhaust, mixed-pressure, back-pressure, and reducing turbines are built on the same general lines, the design being varied to suit the conditions. Small turbines for driving electrical generators of 25 to 200-kw. output are also made, with a single two or three-row velocity wheel; these, it is said, can compete in price and efficiency with the high-speed steam or gas engine. They are extremely light, compact, and simple in construction, and find many useful applications.

Fig. 7 shows the arrangement of the steam-chest, over-speed trip gear, &c., of a high-pressure turbine.

Turning to the subject of alternators, there is no such choice of rival systems as in the case of turbines; practice tends towards uniformity in the main design, and the differences between one and another make depend rather on details of design as regards methods of winding, ventilation, &c., than upon broad principles.



Figs. 5 and 6.—Blading of Velocity-Compounded and Impulse Wheels.

The Westinghouse turbo-alternator has a stator of the usual cylindrical type, consisting of steel punchings rigidly held in a substantial yoke, with air outlet chimneys at both top and bottom; either of these can be used for the discharge of heated air, which is preferably carried away by ducts to the exterior of the building, to ensure quieter running and a cooler engine room. The winding consists of separate bars and end connectors, which can be withdrawn independently for repairs; this system, as shown in fig. 8, allows of a solid bracing of the end connections, a most important matter, without interfering with the ventilation. The conductors are laminated to prevent eddy currents, and in large machines each conductor is insulated for the full voltage between the terminals.

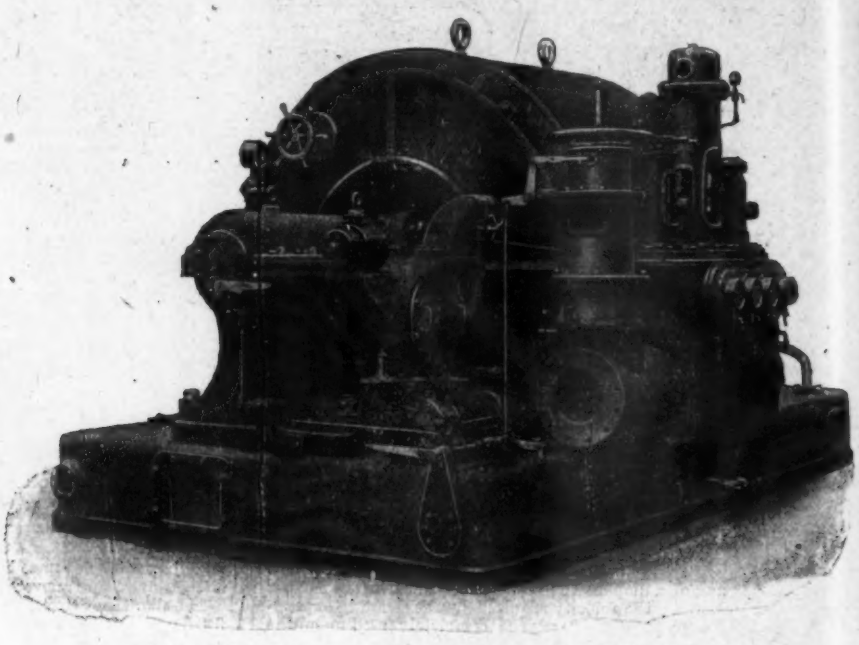


Fig. 7.—End View of Westinghouse-Rateau H.P. Impulse Turbine.

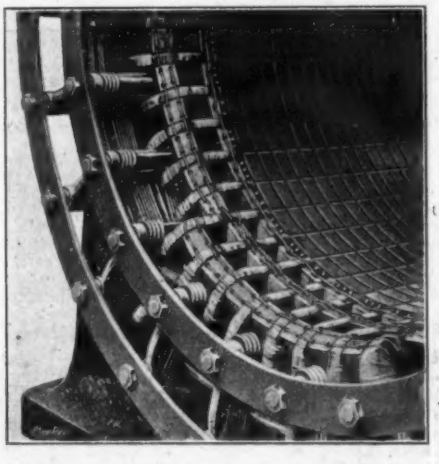


Fig. 8.—Armature Winding of 5,000-kw., 11,000-volt, 1,000-r.p.m. Turbo-alternator.

In small machines former-wound coils are used; one end is left open, to enable the coils to be pushed into the slots axially, after which the ends are connected together.

Fig. 9 shows in detail the method of clamping the end connections with wood blocks and metal bolts. Short-circuit tests at full voltage have been made in many different sizes of machines, demonstrating the ability of the winding to withstand the resulting stresses.

The rotor is the crux in the design of a turbo-alternator, owing to the necessity of perfect balancing at high speeds, ample strength, and adequate ventilation. The end windings in particular present difficulties in design, as they are often of considerable weight, and must be absolutely immovable. The Westinghouse Co. has adopted the smooth cylindrical type with radial slots, which lends itself to the easy anchoring of the winding, large output for size, good wave form, silent running, and facilities for ventilation. The core is usually forged solid with the shaft, of high-class material; the coils are held in the slots by metal wedges, and the end connections are enclosed in steel or bronze end rings. The slots are wide and comparatively few in number, so that the end connections are substantial straps, from 1½ to 2 in. (38 to 51 mm.) wide in large machines, which resist deformation, even if the machine is short-circuited and the rotor brought to a sudden standstill. The blocking at the ends can therefore be reduced to a minimum, and the space utilised for ventilation. Fig. 10 shows a rotor partly wound, and fig. 11 the completed rotor.

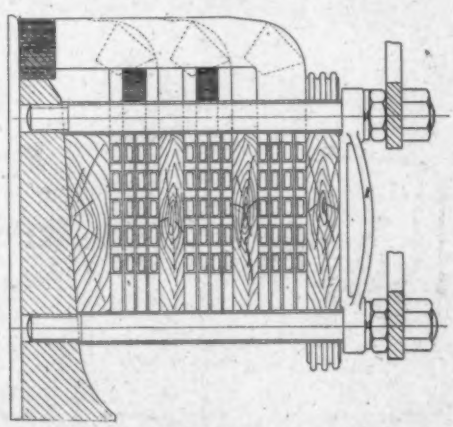


Fig. 9.—Section of End Winding, showing Method of Clamping.

In order to compress the winding and insulation to a practically solid condition, a clamping system consisting of heavy steel rings and radial screws is employed, as shown in fig. 12. By this means a pressure is applied to each coil approximately equivalent to the centrifugal force at full speed, amounting to from 50 to 100 tons per slot on the larger rotors. This high pressure, combined with baking at a high temperature, eliminates all possibility of "breathing" of the coils in service. Each coil is made in one piece without joints.

In turbo-alternators, which give a large output from a small volume of material, efficient ventilation is of supreme importance. In the smaller Westinghouse machines cold air is drawn into the casing by means of fans mounted on the ends of the rotor, and discharged through radial ducts in the stator. The larger machines are provided with the Westinghouse patent radial-axial system, according to which axial ducts carry air from both ends of the machine to radial ducts, from which it passes outward into the yoke (fig. 13). Local heating is prevented by causing the air to be

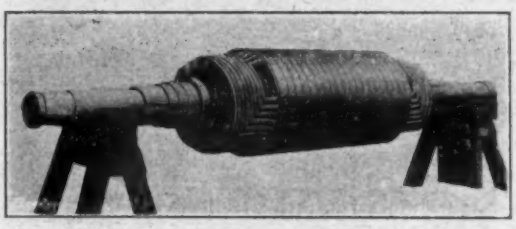


Fig. 10.—8,000-k.v.a., 2,400-r.p.m. Rotor, in course of Winding.

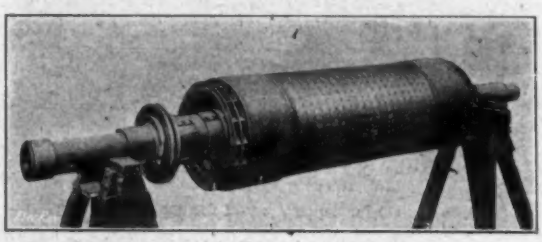


Fig. 11.—Completed 8,000-k.v.a. Rotor.

discharged from the axial ducts over the whole length of the stator core, part of the air from each end being led the whole length of the core. Thus the advantages of uniform temperature and large volumes of air are combined.

The air enters the rotor by way of axial holes extending the whole length of the core, which feed radial ventilation ducts at

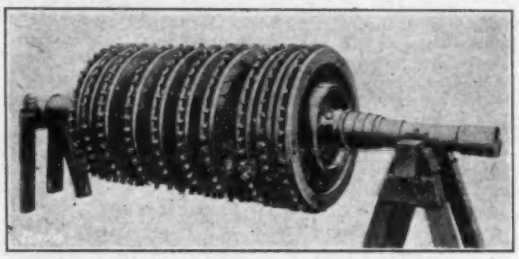


Fig. 12.—Pressing Gear in Position on 5,000-kw. Rotor.

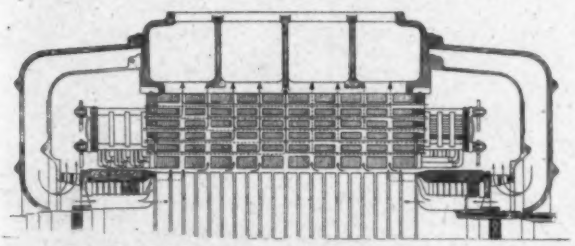


Fig. 13.—Radial-Axial System of Ventilation.

intervals, the air passing across the air-gap and through the radial ducts in the stator core. Special care is taken to cool the rotor end connections, and all machines are made self-ventilating.

The exciter is usually overhung on an extension of the rotor shaft, and generally has a radial commutator, which eliminates the effects of vibration.

In conformity with British traditions, reliability and soundness of construction, combined with high efficiency, have been the fundamental considerations in the design of the Westinghouse turbines and alternators alike, and that success has been attained in respect of these will be admitted. Several machines of 23,500 k.v.a. have been or are being supplied to British power stations, and we have no doubt that larger sizes will be called for at no distant date.

ELECTRIC VEHICLES IN SHEFFIELD.

By J. A. PRIESTLEY.

(Abstract of paper read before the Institute of Cleansing Superintendents.)

Sheffield is easily the largest user of battery-operated vehicles for refuse collection, a purpose for which they are particularly suitable. In 1914, on the author's recommendation, the T.C. made extensive inquiries, and purchased an Edison 2-ton vehicle, which has been at work continuously since September, 1915. The results were so satisfactory that others were ordered, the number at work at the time of writing being eight, with two to follow. In order to facilitate comparison of costs, the author explains that the conditions relating to bin refuse collection in Sheffield are less favourable to the use of motors than in any other place known to him, but the opportunity of using the vehicles on both day and night service is a decided advantage. There are no back streets in the city; refuse collected during the day is carried from bins at the rear of the houses to the street by the workmen, the minimum distance being 20 yards. With horse wagons there are two men, who both help to load; with "electrics" there are three labourers, and a driver who only loads occasionally. The costs given below for bin refuse include all labour in collecting.

Ashpits are emptied by "getters-out," who are paid at piece rates, and wheel the refuse into the front street, where it is loaded into wagons, chiefly at night. Horse wagons are loaded by the driver alone, and electrics by the driver and one labourer. The costs in the case of ashpit refuse are for loading and removal only. The weekly wages at present paid are:—Electric vehicle drivers, 46s.; ditto labourers, 43s.; horsemen, 41s.; horse wagon labourers, 38s. The cost of horse, carter, and wagon is taken at 13s. 6d. a day, to which figure is added the wages paid for labourers.

The working costs of the "electrics" include wages, vehicle costs, tires, and electricity. The vehicle costs are as follows:—

Interest and depreciation (10 years' life) ...	£123	5	10
Insurance	8	10	0
Garage, cleaning, charging, and watering ...	25	2	8
Waste, oil, grease, &c.	6	10	0
Repairs and renewals	43	2	0
	£206	10	6

or £3 19s. 6d. per week, divided equally between day and night work. The tires are maintained under contract.

The batteries are guaranteed to give 100 per cent. of their original efficiency after eight years' constant service. The life of the electric vehicle is necessarily longer than that of a steam or petrol vehicle, with many working parts, and the strains and shocks which it endures are far less with the electric drive, while the allowance for repairs and renewals represents 10 per cent. on the cost of the chassis—an ample provision for 10 years' life. The total mileage per week is very low, and nearly one-half of this is run without load.

The period reviewed is comprised principally between March 26th, 1916, and March 25th, 1917, during which five electric vehicles were in use for different periods. In this year 51,499 tons of bin refuse were collected by horses at a cost of 65·4d. per ton, and 7,040½ tons by "electrics" at a cost of 57·8d. per ton. Of ashpit refuse, 27,878 tons were collected by horses at a cost of 44·5d. per ton, and 10,670 tons by "electrics" at a cost of 26·3d. per ton. The details of the costs of electric vehicles for bin refuse are:—

Vehicle costs, about 3½ years	£331	1	11
Drivers' and labourers' wages	1,230	9	8
Tires—12,640 miles at 1d. per mile	52	13	4
Electricity—19,639 units at 1d. per unit ...	81	16	7
	£1,696	1	6

For ashpit refuse, the electric costs were:—

Vehicle costs, about 3½ years	£362	16	0
Drivers' and labourers' wages	641	5	11
Tires—15,313 miles at 1d. per mile	63	16	1
Electricity—24,716 units at 1d. per unit ...	102	19	8
	£1,170	17	8

As the electrics, with one exception, were working on the longest distances, the comparison is not strictly fair to them. As the long-distance work is taken over from the horse wagons, the horse costs over the city area have decreased, while the electric costs remain at a maximum. In one ashpit district horses and an "electric" worked side by side, with the result that over a period of 23 weeks the average cost was: horses, 66·2d. per ton, and "electrics" 34·2d. per ton.

In addition to dealing with house refuse, the author has used electric vehicles for the removal of clinker residue from the destructor works to tips at a cost of 21·9d. per ton (or 16·4d. per ton-mile), compared with horse labour on the same work, 26d. per ton. On another route, removing clinker, the respective costs were 18·6d. per ton (18·1d. per ton-mile) and 21·6d. per ton; and on a longer route, 19·3d. per ton (11·7d. per ton-mile) and 26d. per ton.

The result of 12 months' working of electric vehicles in Sheffield considered on a financial basis alone is eminently satisfactory.

The work of the five vehicles for varying periods is equivalent to that of 3½ vehicles for the whole year: the saving over horse costs over the whole city amounts to £1,051; capital has been

written off to the amount of £293; electricity supplied from the destructors represents a further sum of £192, making a total of £1,535. Thus 3½ vehicles in one year have cleared off more than the initial cost of 1½ vehicles. If the comparison with horses were made only for the districts now served by the "electrics," the saving would amount to more than £2,000.

The author believes that "electrics" would also be profitable on single shifts only.

	Bin. refuse.	Ashpit refuse.
Average tons per day—horses	3·42	3·63
" " " " —electrics	7·67	10·58
Value of each electric in horses	5·15	

These figures relate to the whole city; the number of horses actually replaced by each electric is a fraction under six.

LEADS FOR ELECTRIC FURNACES.

By Prof. ARVID LINDSTROM.

(Translated from *Teknisk Tidskrift* in *Metallurgical and Chemical Engineering*. Abstract.)

With the increasing size of arc or resistance furnaces the difficulties of conveying the current from the transformer to the furnace have become more pronounced. With electrode potentials as low as 50 and 100 volts the current necessarily will be very high, requiring in turn conductors of a large cross-section, and under such conditions two difficulties are met with.

One is due to the "skin effect," or the tendency of the alternating current to concentrate in the portion of the conductor nearest the surface; the other is due to the self-inductance of the conductor loop which connects the transformer with the furnace, resulting in a low power factor.

It is from the above two points of view that the problem of furnace conductors is dealt with in the following article, and an endeavour will be made to show how the best results may be attained when designing the leads, and also how the results may be investigated by tests. As an illustration, a known furnace installation will be taken for an example.

I.—The Effective Resistance of Large Conductors.

For round conductors Hospitalier has calculated a table for the ratio—

$$\frac{R_e}{R_0} = x = \frac{\text{effective resistance with alternating current}}{\text{resistance with direct current}}$$

as function of f and d, where f is the frequency, and d is the diameter of the conductor in cm. (1 cm. = 0·394 in.).

From this table the following values only will be given :—

fd^2	720,	1,280,	2,000,	2,880,	5,120,	8,000
x	1·32,	1·68,	2·04,	2·39,	3·10,	3·79.

The furnace chosen for the example has a capacity of 900 kilovolt-amperes at the lowest pressure of 50 volts, so that the highest current is consequently 18,000 amperes. The frequency is 50. The conductors consist partly of four bars 200 × 15 mm., spaced comparatively close and connected in parallel. This corresponds to a cross-section of 120 sq. cm., or a round solid conductor with diameter d = 12·4 cm.; fd^2 = 7,700, and therefore x = 3·7.

It may be objected that the conductor did not consist of one single solid round conductor. This is true, but it must be remembered that even if the conductor is split, no gain is made if the spaces between the laminations do not take away any appreciable part of the section, and if instead of being round, the conductor had a rectangular or nearly square cross-section, of the same area, the conditions would not be much improved.

In our case, the four bars are arranged about as shown in fig. 1. The bars are spaced wider apart, and the average specific conductivity is consequently less, but not to such an extent that any

Fig. 1. Fig. 2.

Conductor Arrangement.

appreciable decrease of x is obtained. At the same time as this specific conductivity has decreased, the linear dimensions of the cross-section have increased, and without introducing a too great error, it may be assumed that the resistance in this case is approximately three times as great for the 50-cycle alternating current as for direct current, or x = 3.

Now the question arises: How shall the conductors be arranged in order that a considerably better result may be obtained? The first thing which suggests itself is the use of only one bar, not too thick, but much wider—a bar whose width is 20 to 50 times its thickness.

If h = half the thickness of the conductor in cm.,

$$c = 2\pi\sqrt{\mu\lambda f}$$

where

μ = permeability of the material,
λ = specific conductivity in C.G.S. units,
f = frequency,

and x may be obtained directly from the curve in fig. 3. This is on the assumption that the width of the conductor is infinite in

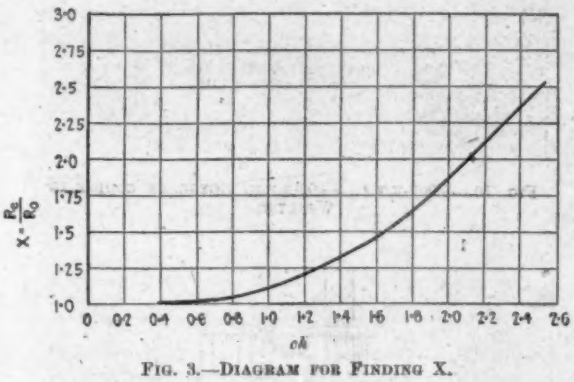


Fig. 3.—Diagram for Finding X.

comparison to the thickness, an assumption which may be considered to apply approximately to our case. When—

λ = 1/2,000 for copper, μ = 1 for copper, f = 50,

then c = 1.

If now the thickness = 2 h = 1·5, 2·0, 2·5 cm.

then $c\,h$ = 0·75, 1·0, 1·25,

and according to fig. 3, x = 1·03, 1·09, 1·21.

In all three cases, but especially in the first and second, a considerable reduction in the loss has been attained with the same weight of copper. We could use a conductor 500 × 8 mm., or only one-third of the originally assumed weight, and obtain the same loss as that now prevailing. Two-thirds of the installed copper could therefore be saved, and the temperature would certainly not be materially higher for this conductor than that of the four bars actually installed.

Even with a single bar 500 × 8 mm., a concentration of the current towards the edges must take place, so that a somewhat increased resistance will result. To avoid this, the conductor may be shaped as a pipe or tube, and if its diameter is fairly large as compared to the thickness of the walls, the calculation used for a bar of infinite width may be applied without appreciable error. With a thickness of 8 mm. the outside diameter of the tube would, therefore, be 500/π + 8 = 168 mm., this being based on the assumed area of 4,000 mm.², which is one-third of that installed (12,000 mm.²).

Instead of an entirely closed tube, it can be separated into two halves as in fig. 2, but in the former case it is possible to provide for a very effective cooling inside the pipe.

II.—The Self-Inductance in Electric Furnace Leads.

The connections between the transformer and the furnace are made as shown in fig. 4. The loop in which the self-induction takes place is a, b, c, d, e, a, and this should obviously be made as small as practical conditions will permit, consideration, of course, also being given to copper weight and energy loss. The distances

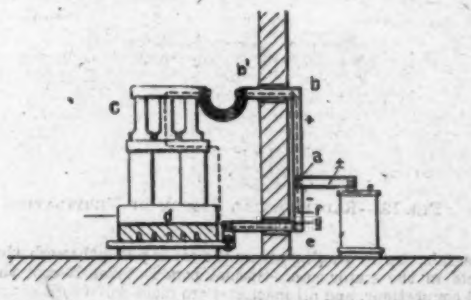


Fig. 4.—Connection between Transformer and Furnace.

bc and be are each, as a rule, approximately 3 m. at least. The question then arises, how can the self-induction in such a small loop, consisting of only one turn, reach such a value as to cause undue difficulties? The inductance L in itself is not large, but the voltage drop caused thereby, $E_s = 2\pi f LI$, is considerable. This is naturally due to the large value of I, and the value seems particularly large when compared to the voltage of the furnace (50 to 100 volts).

By means of the following formula the self-inductance of a round conductor forming a circular loop, fig. 5, can be calculated :

$$L = 4\pi R\,(0{\cdot}58 + \log_e (R/r) - 2\cdot r/R)\,10^{-9} \text{ henry}$$

where R = the radius of the loop in cm.
r = the radius of the conductor in cm.

If, in fig. 4,

$$bc = de = l = 300 \text{ cm.}$$
$$cd = be = l_1 = 400 \text{ cm.}$$

and if the rectangular arrangement is assumed to be changed to a circular one with the same circumference, its radius will be

$$R = (2 \times 300 + 2 \times 400)/2\pi = 220 \text{ cm.}$$

If we also assume that the leads are so heavy and so constructed that the radius of an equivalent tubular conductor is $r = 12$ cm., then the self-inductance will be

$$L = 0{\cdot}934 \times 10^{-6} \text{ henry.}$$

With a current of 18,000 amperes we get

$$E_s = 53 \text{ volts.}$$

For a rectangular loop it is, however, possible approximately to deduce the self-inductance directly as follows : If the self-inductance for the two opposite parallel sides l is calculated in the usual manner and similarly for the two sides l_1, it is evident that the total inductance of the loop will be approximately equal to the sum of the two, and thus

$$L = 4\,(l \log_e (l_1/r) + l_1 \log_e (l/r))\,10^{-9} \text{ henry} = 0{\cdot}934 \times 10^{-6}$$

—(accidentally) exactly the same value as before. This value is, however, too high on account of the fact that the entire side cd, which comprises the electrodes with their holders and the furnace itself, has a considerably greater cross-section (and consequently greater r) than the rest of the circuit. Taking this into consideration, and assuming $r_1 = 40$ cm.,

we get $L = 0{\cdot}836 \times 10^{-6}$ henry,

and $E_s = 47$ volts.

That part of the inductance which is caused by the magnetic field within the conductor itself has been neglected, but when, as previously stated, the current is concentrated near the surface, the error is not appreciable. On the other hand, it may be suspected that the value is too great on account of the fact that the side $b\,c$ partly consists of cables which are spread out considerably, in

Fig. 5.

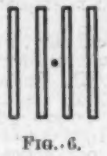


Fig. 6.

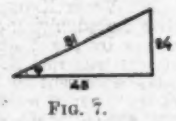


Fig. 7.

which case r, of course, is greater than assumed even for this part of the loop. Furthermore, these cables sag considerably, which makes the area of the loop less. On account of the many irregularities which the loop presents, it is evident that in general only an approximate result can be expected, and in this particular case we get possibly a somewhat too large value for the inductance.

III.—Measurement of Resistance and Inductance in Furnace Leads.

To measure exactly the effective resistance of the furnace leads in our case seems hardly possible. It is customary to measure the inductance by means of voltmeters, ammeters, and wattmeters connected on the primary side of the transformer, but this requires very accurate instruments.

The writer has used a more simple and direct method, consisting in measuring the inductive voltage component of the furnace leads directly with a voltmeter. A pressure wire was placed between the loop conductors, as shown by the dotted line in fig. 4, as well as in fig. 6, where the dot represents the relative position of the wire with respect to the copper bars. The potential between the ends f and g of this wire was determined by a hot-wire voltmeter, which is the only type which can be used within a reasonable distance from the leads on account of their strong magnetic field.

With the furnace in question, the following values were obtained :—

Current in furnace leads = 13,700 amperes.
Voltage at transformer terminals = 51 volts.
Voltage between f and g = 24 volts.

The current was measured on the primary side of the transformer, also with a hot-wire instrument.

The voltage triangle is as shown in fig. 7, so that

$$\cos \phi = 45/51 = 0{\cdot}88.$$

If the current were 18,000 amperes and the total pressure of 51 volts were maintained, the voltage $f\,g$ would be 31·5 volts, and the voltage triangle would give

$$\cos \phi = 40/51 = 0{\cdot}785,$$

which value would apply for our circuit under full load.

One weakness of this measuring method is due to the difficulty in placing the pressure wire just right, in that it cannot, of course, pass centrally through the electrodes and the furnace itself. The inductance voltage will therefore be a little too low, but in any case it may be assumed that measurements with different arrangements of the leads are sufficiently accurate for comparisons.

This installation also contained some older furnaces, the leads of which consisted of copper tubing instead of bars. The leads were furthermore divided into two branches (tubes) carried at some distance from each other. A pressure wire was placed inside one of the parallel pipes, and the following results were obtained :—

Current in furnace leads = 18,400 amps.
Pressure at transformer terminals = 50 volts.
Pressure between f and g (fig. 4) = 22 volts.
Cos ϕ = 0·9.

As cos ϕ in the previous case for the same current was 0·785, it is seen that the older method gives considerably better results as far as the inductance is concerned. This depends partly on the fact that tubes are used instead of the laminated bars, but is principally due to the lead for each pole being divided into two separate tubes. In these tubes, as follows from the above, the increase in the resistance and the additional losses are considerably less than with laminated bars.

IV.—Summary.

In those parts of the circuit between the transformer and the furnace where the two leads come near together (for example, between the terminals of the transformer and point a in fig. 4), there is no difficulty in keeping the inductance or the effective resistance within reasonable limits ; for example, by suitably transposing the positive and negative bars. In cases where the common distance is relatively great, much can be gained by making the leads of two concentric tubes. The inductance as well as the increase in the resistance will thus be a minimum.

In those parts of the circuit, on the other hand, where each lead has a separate path, the use of a single group of laminated bars for each lead would, in general, seem unsuitable, especially where large cross-sections are involved. As near as possible to the place where the leads separate, each conductor should be divided into two groups, placed sufficiently far apart with respect to the length. With a not too great current, each of these groups may consist of a single bar whose thickness should not exceed 15 to 20 mm. If the current is great, so that for practical reasons a total thickness of the bars for each group of more than 20 mm. would have to be used, tubes should be used instead of bars. Otherwise the arrangements should be as stated above—that is, two tubes for each lead should be used, placed at a suitable distance from each other and with a thickness of the walls from 15 to 20 mm. In general, a greater diameter of the tube (and consequently a less thickness of the walls) as well as a greater distance between the groups will give a better result with regard to the inductance as well as to the increased resistance.

LEGAL.

Prust v. Westminster Corporation.

In the Shoreditch County Court last Friday, before his Honour Judge Cluer and a jury, Mr. Prust, of Dalston Lane, N.E., a taxicab proprietor, sued the defendant Corporation for £34 damages to a taxicab. It appeared that at 11 o'clock, on a dark night, one of the plaintiff's cabs, while being driven along Knightsbridge, collided with another cab—a hansom—causing the damage. The alleged cause of the collision was that the Corporation had negligently allowed the electric light to go out at one standard, so that the plaintiff's driver was unable to discern his danger. He saw in front of him two red lights, which he took to be the danger signals put there in connection with an excavation in the roadway. He pulled to the right to avoid it, as he thought, and ran right into a cab which was coming in the opposite direction. As a fact, the red lights were those at the rear of stationary cabs on the rank. Had the electric light been on he would have seen what was happening and avoided any danger. It was argued by counsel that it was the duty of the Corporation to keep these lights going, and they would be responsible for anything that happened if they failed to do so.

For the defence, it was explained to the jury that at times, even though they used the very best of carbons, and took the greatest care, the carbon would fail to drop properly, and out would go the light. The electricity supply was carried out by the Westminster Electric Supply Corporation, who had three men constantly on duty to attend to these light failures. They knew the dangers in view of the darkened streets, and they had had to shade their lights to the required dimness ; besides which, they were even paying the police to give them information of any failure of light. On this occasion they were informed that the light had gone out, and sent as quickly as they possibly could, but unfortunately the accident occurred in the meantime. Counsel raised a number of points for the jury. Under the Defence of the Realm Act, it was an offence to leave a nuisance in the road, and the question was whether this could fairly be described as a nuisance under the circumstances. Again, there was the question whether the defendants had been negligent in having a standard where the light was liable to go out, at such a serious time as this, in the darkened streets. The jury found for the defendants, and judgment was entered accordingly, with costs.

Ryan v. L.C.C.

A South London carman (G. Ryan) was awarded £350 damages, at the Southwark County Court, against the L.C.C. for personal injuries sustained through the wheel of his van catching in a defective tram-rail in Old Kent Road.

Controversy between London Electric Lighting Companies.

At the Surveyors' Institution, Westminster, on Friday, Mr. James Swinburne, F.R.S., as Arbitrator, concluded the hearing of a claim by the Kensington & Knightsbridge Electric Lighting Co., Ltd., for damages against the Notting Hill Electric Light Co., Ltd., for an alleged breach of an agreement.

Mr. Vesey Knox, K.C., and Mr. H. B. Marriott were counsel for the claimants, while Mr. Honoratus Lloyd, K.C., and Mr. Bruce Thomas appeared for the respondents.

In opening, Mr. Vesey Knox said the question was whether the taking of a supply of electrical energy in bulk from the Metropolitan Supply Co., Ltd., and the Hammersmith Borough Council by the Notting Hill Electric Light Co. was a breach of an agreement made in 1909 with the Kensington Co.

Mr. Honoratus Lloyd: I don't accept that. The point I venture to think we have to discuss is in relation to Kensal Town, and not Hammersmith. Kensal Town is the one we referred to the Arbitrator. Hammersmith has cropped up afterwards.

Mr. Vesey Knox said he thought he should be able to satisfy the Arbitrator that the question of the Hammersmith supply should be included. Proceeding, counsel said that in July, 1899, the claimants and respondents (both of whom had statutory powers to supply electrical energy in Kensington) agreed jointly to promote a Bill in Parliament for the purpose of enabling them to acquire land near Wood Lane, Hammersmith, and erect a generating station thereon. It was agreed that the joint station should be constructed with a generating plant of a total power of 1,800,000 watts continuously, and that this output might be used by the parties as they might require, but the claimants were not to be entitled to use more than 1,200,000 watts, and the respondents not more than 600,000 watts, without the consent in writing of the other, and any lesser output was to be available in accordance with the proportions above mentioned. Another clause of the agreement provided that the parties should bear the expense of working, maintaining, and repairing the joint station, and of outgoings and interest on the joint loan by means of a sinking fund, or otherwise rateably in proportion to the amounts of electrical energy taken by the parties respectively from the joint station. The Bill was passed, and by an agreement dated October 25th, 1900, it was agreed that the station should be constructed and equipped by the two companies by means of an issue of debenture stock of a nominal amount not exceeding £200,000, to be secured by a trust deed. Another clause—the one under which the Kensington Co. now claimed—provided:—

"That so long as any of the said stock shall be outstanding the two companies shall from time to time take from the joint station all such electrical energy as each company, having regard to its other sources of supply, may require for the purposes of its business in accordance with the provisions of the agreement of 1899, or such other provisions as may from time to time be agreed upon between the two companies or settled unanimously by the Committee of Management."

The trustees for the debenture-holders (said counsel) were obviously not satisfied to lend their money unless the principal agreement was strengthened in that manner. It was further provided that the property, after the redemption of the stock, should belong to the claimants and the respondents in the proportions to which they should be entitled, as tenants in common, in such shares as should be in proportion to the amounts of their respective contributions. The respondents had in 1909, and since, taken a supply of electrical energy in bulk from the Metropolitan Electric Supply Co., Ltd., and they had also taken a supply from the Hammersmith Borough Council. Claimants submitted that the Notting Hill Co. had thus committed a breach of their agreement. As a consequence, the expenses of the joint station to be paid by the claimants were increased to the extent of £1,650 from 1909 to the end of 1915. The figures for 1916 had yet to be supplied by the respondents. The Kensington and Knightsbridge Co. accordingly claimed damages, and a declaration that the respondents were bound to take electrical energy in accordance with the agreement. The respondents, in their defence, denied any breach of the agreement, and declared that the claimants expressly or impliedly requested them to take, or so agreed to them taking, the supply from the Metropolitan Co., and to waive such breach, if any. Respondents further stated that they relied upon the following circumstances:—"In 1907 certain parties in the Borough of Kensington, outside the areas of supply of both the claimants and respondents, being anxious to obtain a supply of electricity, representatives of the two companies met and discussed the question of such supply being given by the respondents. The parties in question were Messrs. W. N. Davis & Son, of Kensal Dye Works, South Row, Upper Westbourne Park, W. As a result of the discussions, it was determined that the respondents, not being able to give the supply themselves, should arrange for it to be provided by the Metropolitan Supply Co., Ltd. The respondents accordingly made such arrangements, and obtained authority from the Board of Trade to give the supply. The decisions referred to were made at one of the weekly meetings which took place during July, 1907, at which the claimants were represented by their then secretary (Mr. Erskine), and the respondents by their secretary (Mr. Rawkins) and their chief engineer and manager (Mr. G. Schultz), and had been acted upon ever since with the full knowledge of the claimants. Since Messrs. Davis & Son were first given a supply of electricity, other parties outside the respondents' area of supply had been supplied in the same manner, and the claimants had been at all times aware of it, and had acquiesced therein. These other parties included a L.C.C. school in Middle Row; the London General Omnibus Co.; Middle Row Garage; William Whiteley, Ltd., 222, Kensal Road; Globe Wernicke, Ltd., Kensal Road; and the Roman Catholic Schools, Bosworth Road. In the further alternative, if the supply in question was a breach of the agreement, the respondents contended that it was authorised by the London Electric Supply Act, 1908. They further submitted that they had at all times taken such a proportion of the output of the joint station as was reasonable, and, in the alternative, if the supply was not in compliance with the agreement, that the claimants were not entitled to any payment or to claim any damage in respect of any period prior to the date when the claimants first represented to the Committee of Management that the respondents were not taking such a proportion of the output of the joint station as was reasonable."

Proceeding, Mr. Vesey Knox said it was not till 1916 that the directors of the Kensington Co. had any knowledge of any supply being taken by the respondents from the Metropolitan Co. They immediately made a complaint, and as it had not been met they brought the matter before the Arbitrator. Counsel said it was apparent on the score of cost that the respondents had a strong motive for taking the supply from the Metropolitan Co. and not from the joint station.

Mr. Honoratus Lloyd observed that the Metropolitan Co. laid the mains, and the Notting Hill Co. paid for them.

Mr. Vesey Knox: If the Metropolitan Co. laid the mains they broke the law. The Notting Hill Co. have got the power to break up streets by these "fringe" orders.

The Arbitrator inquired when the Hammersmith supply began.

Mr. Lloyd: In 1906, sir.

Mr. Vesey Knox (glancing at a document): It says 1908 here. It must have been trifling in 1906.

Mr. Lloyd: It has always been trifling. It would affect the Wood Lane account in respect of your supply not more than £5 a year.

Mr. Vesey Knox, continuing, submitted that it was clear that the supplying of various customers under the "fringe" orders by the Notting Hill Co. was part of their business. It was true that the annual accounts of the respondent company were sent to the claimants, because it was the custom of the London electric light companies to exchange accounts, but the directors did not notice that those accounts contained year by year an item of "Electricity purchased from other sources."

The first witness was Mr. Herbert Woodfield Miller, who said he had been managing director of the Kensington Co. since April, 1914, and that prior to that for some 20 years he was the chief engineer. Mr. Erskine was the secretary of the company during his (Mr. Miller's) association with it to June, 1913, when he died. During that time witness was practically in daily communication with Mr. Erskine, who never mentioned a word about any such arrangement as that alleged by the respondents. Witness had searched through Mr. Erskine's papers, and had not been able to find a single document or note relating to the alleged arrangement. Towards the end of 1914 Mr. Rawkins told him the respondents were going to enter into an arrangement with the Omnibus Co., that it would be a good stroke of business, and that the supply would be given by the Metropolitan Co. Prior to that he had no knowledge or notice that they were getting a supply from the Metropolitan Co.

Col. Crompton, C.B., a director of the claimant company since 1901, and chairman of the board of directors since 1903, said that if Mr. Erskine had mentioned anything to him about the respondents being supplied by the Metropolitan Co. he should have objected very strongly.

Sir Henry Bliss, a director of the Kensington and Knightsbridge Co., said that until Mr. Miller brought the matter before the board of directors on March 30th, 1916, it had never come before the directors in any shape or form.

Mr. G. S. Britton, secretary of the Kensington Co., who succeeded Mr. Erskine, also gave evidence.

This was the case for the claimants.

Mr. Honoratus Lloyd, for the respondents, said he began by protesting against the inclusion of the Hammersmith matter, and he adhered to that. The question arose with reference to two groups of consumers, one in Kensal Town and the other in Hammersmith. So far as the Kensal Town customers were concerned, they had never been in the area of the respondent company, and were not within their area now, and the respondents had no right to supply them or lay a main or anything else until after 1910, when they obtained some "fringe" orders. In Hammersmith the customers, originally 14 in number, now numbered four—at any rate, four had now come into the area upon the recasting of the boundaries. It was admitted that at the time of the agreement the respondents had one source of supply, which was their own generating station, and that this was sufficient to have supplied both the customers at Kensal Town and Hammersmith. Therefore, he submitted, under the agree-

ment, having a source of supply which was ample, the company was not obliged to take the supply from the joint station. If he was right in that construction of the clause in the agreement there was an end of the whole case. With reference to Kensal Town, it was not legal for the respondents to supply the consumers until the "fringe" orders were obtained. It had been said by his learned friend that Kensal Town came within the respondents' business. He (Mr. Lloyd) submitted that it must be a legal business, one they were entitled to carry on, and until the "fringe" orders it was an illegal business, and, as such, certainly could not be business which would come under the agreement. Regarding the position when the business became legalised, counsel quoted from the Act of Parliament sanctioning the erection of the joint station with the object of showing that it was "for the purpose of supply within the respective areas of supply" of the two companies, and to certain specified bodies—the Vestry of St. Mary Abbotts, Kensington, and Hammersmith for the White City.

The Arbitrator: Do you contend that the joint station is not even now available for supplying under the "fringe" orders?

Mr. Lloyd: I do. Although I submit that the decision of the company has been legalised by the "fringe" orders, it has not enabled the supply to be given from the joint station for that purpose. Those are a few points of law I submit to you. Counsel went on to refer to the respondents' submission that the taking of the supply from the Metropolitan Co. was known and consented to by the claimants. In 1907, when they had an isolated request from Kensal Town Dye Works, who threatened them with the Board of Trade, they thought at the time those works were in their district, and that occasioned more worry still. Mr. Rawkins had interviews with Mr. Erskine, and the latter agreed that it was the wisest and best thing to give this one customer a supply. As time went on other customers came in, and Mr. Rawkins used to tell Mr. Erskine the price he was getting. The real point was that that was done as a perfectly reasonable thing, having regard to economic considerations. It was admitted that it would have been an uneconomical thing for the respondents to have supplied the customers direct from their own generating station because of the distance, and what was done was done with the knowledge and acquiescence of Mr. Erskine.

The Arbitrator: The question is having done it, and received benefit, have the other side any right to part of that benefit? That is a legal question. The other question is economy—whether it would have been wise in the circumstances to take it on at all if you had had to do it yourselves. I appreciate your argument that the joint station still has no power to supply it. That, of course, stands out by itself. It has nothing to do with the other points.

Mr. Lloyd submitted, lastly, that even if he was wrong in law and fact, the claimants had suffered no damage.

Evidence was then given in support of counsel's statement by Mr. Rawkins, who said he had been secretary of the Notting Hill Co. since 1903, and manager and secretary since 1913. Mr. Erskine quite agreed that he should go to the Metropolitan Co., and upon the report of Mr. Schultz (who was manager and chief engineer up to 1913, and who since then had been consulting engineer), the directors determined to make arrangements to obtain the supply from the Metropolitan Co. On the report of Mr. Schultz, the respondents would not have supplied this had it not been possible to obtain a supply from the Metropolitan Co.

Mr. Schultz and Mr. Macdonall also gave evidence for the respondents, as well as Mr. Sparks, the President of the Institution of Electrical Engineers, whose testimony was of a technical character, dealing with economic considerations.

It appeared that the claimants had based the amount of their claim on figures supplied by the respondents of the quantities of electric energy purchased by them from other sources. The figures included a certain quantity supplied by the Hammersmith Borough Council. While not agreeing to the inclusion of the Hammersmith matter in the case, Mr. Lloyd consented to the figures being included, and learned counsel on both sides agreed that for the purposes of the case the damages should be put at £1,900 up to 1916.

Mr. Vesey Knox remarked that the primary object of the claimants was to get the agreement construed, although they did not know of the supply by the Hammersmith Council until respondents sent them the figures.

Mr. Lloyd: It would be hard if you were found to be right over Hammersmith, and we had to pay all the costs when it is not in the reference.

The Arbitrator pointed out that the costs were within his discretion, and observed that if he found that the Hammersmith question was not before him he could wipe it out.

At the conclusion, the Arbitrator intimated that he would state his award in the form of a special case, but in view of the Long Vacation there was no immediate hurry.

Electricity Supply Tariffs.

The Hackney Case.

The hearing of this case was commenced in the Chancery Division on Tuesday last. It will be reported in later issues.

WAR ITEMS.

More Appreciation from the Forces.—A Lieutenant with the Tyne Electrical Engineers, R.E., writes:—

"The letter from a lance-corporal in the L.E.E. which appeared in this week's Review awakens me to my sense of duty, and a very pleasing one it is. Unless one has actually been to all intents and purposes completely isolated from the outside and commercial world, it were impossible to realise the help and benefit derived from the good old Electrical Review received each week. Although never in the same place for more than a few days at a time, I always receive the welcome copy from my central address, and I quite agree with our L.E.E. friend that without your weekly gift we should be out of the times to such an extent that in the better days to come we might find ourselves permanently handicapped. I'm sure there are many who would echo these sentiments, and were it not for military pressure of duties you would weekly be inundated with budgets of appreciative correspondence. Perhaps our occasional slackness in writing is due to the fact that we now consider the weekly advent of the Electrical Review in the nature of a priceless institution. Be that as it may, you are undoubtedly doing the industry one of the best of modern services, and the thanks of the profession are due to you accordingly. May you continue to prosper and carry on the good work till the old times come again, when I doubt not but what your reward will be superabundantly fulfilled."

Leaving Certificates.—A protest was made at the meeting of the Radcliffe (Lancs.) Urban District Council last week against the decision of the Electricity Committee, by five votes to two, to refuse a leaving certificate to the second engineer. Coun. Atherton said the certificate should have been granted. It had not been granted because the applicant happened to be a working man who desired to improve his position. The Committee's decision would probably have been different had it been an official who had obtained promotion. He knew there was a scarcity of labour, but other undertakings were similarly situated. Coun. Lord, the chairman of the Committee, said the engineer was away when the Committee met, and the matter was really deferred so that he could be present to state his case. Several members asked if the position at Birmingham was still open, and the chairman replied in the negative. A member: Then he has lost his chance. The Council referred the minute back, Coun. Brooks saying it amounted to a censure upon the Committee. Coun. Whewell said the man could have applied to the Board of Munitions for a leaving certificate, but unfortunately he did not take that course.

After the War.—Speaking at the annual meeting of Messrs. J. Tylor & Sons, Mr. Philip Bright referred to the subject of Labour conditions after the war. As reported in the *Financial Times*, he said:—

"About two months ago we, in common with almost all other engineering firms, had a strike, which lasted more than a week and affected the month's output considerably. The causes were at the time obscure, but I have recently been investigating them, as one of the Commissioners appointed by the Government to look into the question of industrial unrest in the North-East area. Our report is now in the hands of the Government, and I hope that steps may be taken to remove any grievances which may have been found to exist. Personally, I am strongly of opinion that if the workman can be persuaded to increase his output and to utilise to the fullest extent every appliance which science, allied with capital, can provide, capital can and must afford him a more liberal reward in return for his labour and a reduction of working hours to permit him to enjoy the greater leisure and recreation which will be his due. The majority of employers and workmen are coming to regard conditions of employment from a more reasonable standpoint than they did in the past, and they ought to combine to influence the extremists of both classes who resist the introduction of methods which, if properly applied, must tend to improve the relations between Capital and Labour. Deliberate restriction of output, as now widely practised, is wholly indefensible, but it has been encouraged in the past by some employers who regarded large earnings on the part of workmen with suspicion and disapproval. In America wages are much higher than they are here, and the output per man is enormously greater, and it is in that direction that we must travel if the wealth which has been so wantonly destroyed during three years of war is to be restored. It is now generally recognised that all the pre-war conditions which existed in engineering workshops cannot be restored without a very serious loss of efficiency; indeed, such restoration would be as retrograde a step as the suppression of motor traction in favour of horses. We must, however, bear in mind that the Government is definitely pledged to such restoration, and we are in honour bound to see that Labour is in no way prejudiced if it loyally accepts—as I believe it will—a reasonable modification of that undertaking."

Mr. Andrew Fisher, High Commissioner for Australia, addressing business-men in Belfast recently, said that after the war approximately two years would be occupied in returning to the Dominions the men who had come to fight the

enemy. That meant that a certain amount of shipping would be utilised, and that to a large extent the productive services of these men would be lost during that period, while all the time the Germans would be making goods for us unless we put up our hands now and told them that they could not come in. We had the men, the initiative, and the enterprise to found new businesses, but Government help must be guaranteed. He, for one, hoped that Free Trade as it was known before the war would never rear its head again.—*Daily Telegraph.*

Mr. J. L. Garvin, speaking to the United Workers, at Burlington House, said it was the sheerest moonshine madness to imagine that the problems of peace might be left till peace was declared, and that all our efforts should now be concentrated on the war. The nation which could demobilise most speedily would secure an enormous advantage which it would be difficult to overtake. Britain would have to demobilise by ships, and the Continental Powers, fighting on their own territories, by rail. Germany had perfected her railways, while we had torn our lines up. We had a diminished fleet, and must leave large numbers of our workers abroad while we carried to their homes the Colonial and American soldiers, and this with a sadly diminished fleet. We had to find work for 8,000,000 persons, and build, at the smallest computation, 150,000 houses with a lack of raw material for the purpose. France and Belgium could not wait for their rebuilding, but must take the first comers. It was the most imperative and urgent problem Great Britain ever had to face. The first desideratum was the compilation of a national register with a record of all the soldiers and munition workers and the available stock of machinery. Disaster would certainly come from Labour difficulties unless Capital and Labour could come to a common agreement for the production of a new industrial charter. A career must be offered to the worker, who should not be allowed to drift from employer to employer, and there must be some return to the older and more kindly social relations. Larger social ambitions must be excited and gratified for him.—*Daily Telegraph.*

Mr. George Lansbury, writing to the Stepney and Poplar Federation of the Church of England Men's Society on Labour problems after the war, said: "It is no use thinking of reorganisation merely for the purpose of more money-making. We must recognise the value of a thing not by its cost, but its utility. We have degraded Labour and ourselves by putting money value on all our services. Most of us have lived long enough to know that we cannot put a gold value on the things we most care for. Therefore, Labour and Capital must come together on a co-operative basis—Labour giving its industry, organised into industries or guilds, and Capital giving its brains, both as parts of the great business of co-operative production and distribution."—*Daily Telegraph.*

The *Times* reports a speech delivered by Lord Leverhulme at the Aldwych Club luncheon last week on after-the-war problems. We quote the following therefrom:—

"In what way, asked Lord Leverhulme, were we to make the best of our position? The present antagonism between Capital and Labour ought not to exist. Capital and Labour must be fused into one. Co-partnership was the one basis of commercialism; but it must not degenerate into charity or philanthropy. Its object must be increased efficiency and increased prosperity for all; and it must maintain supremacy of management, and Labour must be free to work out its own ideals; and there must be greater stability in the arrangement than a mere cash bonus. Further, the benefit must extend to wives and children—he attached the utmost importance to this—and a man must know that his share in co-partnership would on his death go to his widow during her widowhood. This benefit would elevate management and labour equally in the social scale, and would not be antagonistic to the legitimate rights of workers. Control must rest with those who found the cash capital. If we had co-partnership on these lines there would always be the underlying wages system. This must be maintained on the highest scale practicable to the industry concerned. The bulk of production was done by machinery, which was getting more and more complicated and costly every day. Would it not be better, instead of running it eight hours a day, to have two shifts of six hours each? With such a reduction in hours, and two shifts, there would be an increased output and there would be an enormous national gain. The days lost through illness would be decreased by 25 per cent., and the breakdown of machinery would also be reduced. This was the outline of the vision he had of meeting the conditions that he thought would arise after the war. The greatest stimulus required was profit-sharing, which would humanise industry and make the working man no longer antagonistic to the capitalist, because he himself would be a capitalist."

Trade After the War.—Lord Balfour of Burleigh's Committee on the question of Trade After the War met at the House of Lords last week, when important evidence was taken.

Exemption Applications.—At the Shoreditch Tribunal, Mr. J. Berg, aged 34 years, of 169, City Road, E.C., electrical engineer and scientific instrument maker, made a third application for exemption. He said he was carrying out a lot of electrical work for instruments in connection with the war. He was a Russian Pole. The Tribunal granted one month, final.

At Maidstone, Mr. O. Jones, electrical engineer, appealed for E. Wicks (28) and W. H. Brown (37), employed on electrical plant at local works and institutions. Each was allowed three months.

Sheffield Tribunal has granted exemption until December 31st to C. West (37, Class C 3), electrician, appealed for by the Lyceum Theatre, Ltd.

Hitchin Rural Tribunal has given six months' exemption to E. A. Blindell (22, Class B 3), electrical engineer to Mr. Marlborough Pryor. He was discharged from the Household Cavalary in consequence of a dislocated knee.

At Bexhill-on-Sea, on the appeal of Mr. Baker, of Station Road, six months' conditional exemption was granted to F. W. Climpson (B 1), electrician.

With the assent of the military, exemption whilst engaged in the same trade has been granted to A. T. Clarke (33, Class C 3), electrician, Weymouth.

Hastings Tribunal has granted three months' exemption to J. P. Murray (31, B 2), fitter's mate, and N. W. J. Bissenden (22, B 3), wireman, appealed for by the Tramway Co.; six months to C. Gower (39, C 2), tramway motorman; and conditional exemption without time limit to J. C. Sweatman (35, C 3), electrician.

At Brierley Hill, Messrs. Holmes & Cartwright appealed for their electrical engineer and fitter (27, B 1), said to be the only electrician left in the town. Three months were granted.

At Accrington Tribunal, application was made on behalf of six tram drivers for leave to bring their appeals before the Tribunal. The men ranged from 35 to 38 years of age. One half were Class A men and the other half were Class B. The Military Representative said he had gone into these cases along with the tramway manager, and they came to an agreement after making allowances for other men. It was too late in the day to re-open the cases. Mr. Britcliffe suggested that if the men had to go into the Army some of the tramcars would have to stop. The Tribunal refused to re-open the cases, with the exception of a B 2 man, who could have a fresh examination. If, however, he was returned in the same category he would have to go with the rest into the Army.

BUSINESS NOTES.

Commercial Intelligence Work of the Board of Trade.—At a meeting of the Advisory Committee of the Board of Trade on Commercial Intelligence on July 4th a report was presented for the quarter ended June 30th, 1917. According to the *Board of Trade Journal*, among the other matters considered by the Committee were the future organisation and scope of the British Industries Fair; co-operation of the Board of Trade with trade associations in the investigation of foreign markets; the revised instructions to Trade Commissioners; the commercial mission now in progress in Spain; and proposals for the formation of a Latin-American Association.

Japanese Electrical Exports to China.—According to a recent official report, Japanese electrical materials are being imported in considerable quantities into the Upper Yangtze district of China.

Book Notices.—*Farming by Motor.* London: Temple Press, Ltd. Price 1s. 6d. net.—This interesting booklet briefly summarises the leading particulars of about 20 types of farm tractors and motor ploughs, and illustrates and describes the work which they may be expected to perform. It is intended as an aid to the farmer in securing the machine best suited to his own conditions, and, needless to say, its sponsors, the *Motor* and *Commercial Motor*, have made the most of a pet subject in the limited space at their disposal. The book would be much increased in value by the addition of actual data as to cost of operating different machines under varying conditions of practical farm work; and the farmer would probably prefer to be warned of the possible defects of new implements rather than find them out by personal experience or trial. But if we admit certain shortcomings inherent in new appliances, the oil-driven farm implement is still one of the best means of labour-saving, and, as such, should be encouraged in every possible way.

"Technical Papers of the Bureau of Standards." No. 90. Structure of the Coating on Tinned Sheet Copper in Relation to a Specific Case of Corrosion. No. 91. Temperature Measurements in Bessemer and Open-hearth Practice. Washington: Bureau of Standards, Department of Commerce.

Catalogues and Lists.—BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—List No. 4,160 (20 pages) contains full description, with many illustrations, connection diagrams, and tabulated particulars, of the company's ironclad draw-out oil-break switchgear (type O, forms J_1 and J_2).

THE KLAXON CO., LTD., 1, King Street, St. James', London, S.W. 1. Small booklet of 24 pages, giving illustrations of a few of the purposes for which their Klaxon warning signals are suitable.

Liquidation.—RURAL DISTRICTS ELECTRIC UNDERTAKINGS, LTD.—Winding-up voluntarily. Liquidator: G. W. Brown, 24, Martin's Lane, Cannon Street, London.

LIGHTING AND POWER NOTES.

Bradford.—B. OF T. ELECTRICAL SUPPLY COMMITTEE.—The Corporation Electricity Committee has passed a resolution fully endorsing and supporting the action taken by the Hammersmith Electricity Committee in suggesting that Electricity Committees should combine to demand that the B. of T. Committee should be dissolved, and replaced by competent, unbiassed persons not directly interested in electrical matters.

The Electricity Committee has decided to provide a special coal siding on the Midland Railway at Canal Road, and to install conveyors between the siding and the electricity works as soon as authority for the work can be obtained.

Bury St. Edmund's.—YEAR'S WORKING.—The borough electrical engineer's report on the working of the electricity department for the year ended March 31st last, shows that the units sold amounted to 281,507, as compared with 302,680 in 1916. The total income was £4,875, and working expenses £3,828, leaving a gross profit of £1,046; after meeting interest and sinking fund charges and other expenses, there is a deficit on the year's working of £1,037. The cost per unit sold has risen from 2·34d. to 3·15d.

Canada.—ONTARIO POWER CO. PURCHASE.—By the purchase of the generating plant of the Ontario Power Co., Niagara Falls, Ont., the Hydro-Electric Power Commission of Ontario have acquired the largest generating plant in Canada. The capacity of this plant is in the neighbourhood of 175,000 H.P.

The arrangement, briefly, amounts to the assumption by the Ontario Government of a bond of issue of $14,699,000, the payment by 4 per cent. 40-year debentures at 80 per cent. of its par value for $10,000,000 of capital stock, and the assumption of all Canadian and United States contracts. The financial obligation thus amounts to $22,669,000, on the supposition that all the common stock is turned in, and the contracts include the Commission's own contract for 100,000 H.P., as well as a contract with the Ontario Transmission Co., which distributes throughout the Niagara Peninsula, for 60,000 H.P. There is also assumed a contract for the supply of 60,000 H.P. on the United States side of the line. It will thus be seen that the Ontario Power Co. held contracts for supplying up to 220,000 H.P., which necessitated the purchase of a considerable quantity of power. This, by an old agreement, is being obtained from the Electrical Development Co. The agreement for the supply of 60,000 H.P. to the United States terminates in 1950; the price received is $12·50 per H.P. The United States company owns its own distribution system.

The Ontario Commission is, therefore, distributing at the present time in the neighbourhood of 300,000 H.P. This is made up chiefly of the 220,000 H.P. obligation assumed from the Ontario Power Co., 50,000 H.P. purchased from the Canadian Niagara Power Co., the generating plant at Eugenia, the Severn River plants, and the numerous developments recently taken over in Central Ontario from the Electric Power Co.—*Canadian Electrical News.*

The Shawinigan Water and Power Co. is constructing a 100,000-volt transmission across the St. Lawrence River. This will take the form of a 5,000-ft. span of three steel cables carried on towers 350 ft. high, which will rest on concrete piers in the river. The cable supports on the towers are on the same level but 50 ft. apart; the cables are to be brought down behind the towers and anchored. The spans will require to be insulated at either end, and the insulators will, in addition to the electrical stress, have to withstand a mechanical stress of above 150,000 lb. each.

Continental.—PORTUGAL.—A Bill has recently been introduced into the Portuguese Chamber of Deputies, under which it is proposed to grant State assistance towards the establishment of new industries and the development of existing ones in the country. Among the undertakings which it is proposed shall come within the scheme are:—The utilisation of available water power and the manufacture of electrical material and electro-chemical products.

SPAIN.—Application has been made by Julian Hernando, of Santa Cruz del Valle, for a concession to establish a generating station and erect transmission lines for the supply of electric energy to Santa Cruz del Valle, Soto Garganchon, and Valmala.

ITALY.—The Società Generale Italiana Edison di Elettricità has published the conditions of a prize competition for an electric kitchen to serve a family of five or six persons, which it has established. Ten thousand lire have been set apart for the prizes, up to three in number. Five judges have been nominated—namely, one member each from the Milan Royal Technical Institute, the Associazione Elettrotecnica Italiana, the Associazione Esercenti Imprese Elettriche, the Lega Economica Nazionale, and the Società Edison. —*Elettrotecnica.*

Chippenham.—The U.D.C. has decided to have the electric light installed at its offices.

Crosby.—The P.C. has appointed a deputation to confer with the Scunthorpe U.D.C. relative to the latter's application for a prov. order for electric supply in the parish, and to which the Council is favourably disposed.

Darton.—The U.D.C. has sanctioned the application of the Yorkshire Electric Power Co. to erect an overhead line from its power station at Barugh to Gawber.

Dover.—The T.C. has decided to extend the mains so as to supply current to a local hospital. The Post Office having taken only 9,989 units instead of 12,000, the guaranteed minimum, the T.C. has asked the department to pay 4½d. per unit for 10,000 units, instead of 4½d. and 4½d. per unit beyond, as originally agreed.

Exeter.—YEAR'S WORKING.—The annual report of the city electrical engineer (Mr. H. D. Munro) states that the accounts of the undertaking for the twentieth completed year of working show a gross surplus of £9,789, as against £7,719 in the previous year, and a net surplus, after meeting interest, sinking fund, and income-tax charges, of £2,043. A total of 1,972,288 units were sold, a net increase of 207,065. The loss of revenue by reduced public lighting is made good by an increase in the tramway supply. Allowing for stock differences, the actual consumption of coal has been further reduced by 200 tons, in spite of the increased output, and the Committee has been able to effect economies in nearly every other item of the expenditure account. As a result, the overall cost of production per unit has been brought down by nearly 12 per cent., in spite of the enhanced cost of all materials. The number of consumers has increased by only 55 during the year, owing to the difficulty of obtaining cable for connections, but 15 of these were for power supply, of which an additional 140 H.P. has been connected.

Greasbro'.—PROV. ORDER.—The U.D.C. has considered the notice dated June 8th, 1917, of the intention of the Rotherham Corporation to apply for a prov. order to supply electricity within the district, and has decided not to assent to the proposals. The Council intends to apply for a prov. order itself, and the Rotherham Corporation is to be asked for its terms for a bulk supply, so that the Council will be able to supply to consumers at rates not higher than those charged within the borough.

Halifax.—Yesterday a new 6,000-KW. turbo-generator was to be officially started-up at the Corporation electricity works, Lady Rhondda having consented to perform the ceremony.

Hucknall Torkard.—PROVISIONAL ORDER.—The U.D.C. is to oppose an application by the Nottingham T.C. for a provisional order for electric supply, as the Sherwood Colliery Co. has already offered a supply of current after the war.

Itchen (Hants).—PROPOSED BULK SUPPLY.—The U.D.C. has appointed a Committee to discuss the question of obtaining electricity in bulk for distribution in the district.

Kirkby-in-Ashfield.—E.L. PROPOSALS.—The U.D.C. has decided to call a special meeting to discuss the application of the Nottingham T.C. for a provisional order for electric supply.

Kirkcaldy.—The T.C. having been refused permission to borrow £27,000 for extensions at the electricity works, has decided to apply for powers to borrow £7,000 for a high-pressure cable from the generating station to the Pathhead district.—*Glasgow Record.*

London.—L.C.C.—The Finance Committee has, with the Council's sanction and with the approval of the Treasury, agreed to advance on loan £9,185 at 5½ per cent. to the Hackney B.C. for electricity purposes.

STOKE NEWINGTON.—The Electric Lighting Committee reports that in view of the probable shortage of coal supplies during the coming winter, it has had under consideration the charges for domestic heating, which are at present 4½d. per unit for the first hour's daily use of the maximum demand, and 1d. per unit for all further consumption. As an alternative, the Committee recommends that a flat rate of 2d. per unit be offered for domestic heating, cooking, &c., to all lighting consumers.

SHOREDITCH.—WHISTON STREET EXTENSION.—The revised estimate of the total cost of the proposed extension totals £51,500, as against £41,000 for which sanction has been obtained. The Electricity Committee recommends that application be made to the L.C.C. for sanction to a further loan of £10,500 necessary owing to the rise in prices consequent on war conditions since the original estimate was prepared; and that the L.C.C. be requested to consider the granting of the longest possible terms for the same and the lowest rate of interest.

HAMMERSMITH.—The Electricity Committee has received a letter from the Controller of Coal Mines with reference to the proposed interconnection of the electricity stations at Battersea, Fulham, and Hammersmith, stating that in view of the urgent necessity of reducing the coal transport for the London area during the coming years, the Controller was anxious to assist in the fair apportionment of the total cost of carrying out the scheme which was approved in principle in June, 1915, and asking if the B.C. was willing to submit the matter to an arbitrator to be appointed by the B. of T., whose decision should be final. The Committee has approved the suggestion.

Rotherham.—Mr. Garnham Roper, of the B. of T., has held an inquiry in London relative to an application by the Corporation for a prov. order to supply electricity in bulk to the Mexboro' and Swinton Tramway Co. The prov. order was granted, but was limited to the period of the war and 12 months after.

Sunderland.—PRICE REVISION.—At a meeting of the T.C., on the 11th inst., the Electricity Committee submitted a report which (*inter alia*) recommended that the tariffs for the supply of electricity be revised. Mr. G. S. Marshall contended that it was unfair that the revision should only apply to the small consumer. Alderman Bruce said the large consumer was under a sealed contract, and that the small consumer had never contributed anything towards the increased cost of coal until last year, while the shipbuilders—the large consumers—had always paid for the increased cost of coal. Eventually the report was adopted.

Southport.—The Corporation Electricity Committee has given permission to the Birkdale & District Electric Supply Co. to charge an additional 5 per cent. to private consumers of electrical current in Birkdale, on condition that the increased profits on receipts shall not be taken into account in the event of the subsequent purchase of the undertaking by the Corporation, and on the condition that the increased charges do not exceed those charged by the Corporation.

Stoke-on-Trent.—Price Increase.—The T.C. has further advanced the price of current from the meter readings at the end of the September quarter by 8½ per unit, making a total increase since the war began of 33½ per cent.

Sutton-in-Ashfield.—Proposed E.L.—The Nottingham T.C. has informed the U.D.C. that application is to be made to the B. of T. for a provisional order for electric supply.

Taunton.—Year's Working.—The accounts of the Corporation electricity undertaking for the last year of operation show a gross profit of £5,467, of which £3,532 has been absorbed by loan charges, &c., and £521 transferred to the reserve account.

U.S.A.—According to the *Electrical World*, the Cincinnati Public Service Authorities intend to improve the lighting in 14 miles of streets, at an estimated cost of $140,000. Some 913 new lamps are included, and 294 old arc lamps will be displaced. The new lamps will be of a 16-C.P. tungsten-filament nitrogen-filled type of 20-ampere 14·1-volt rating, placed 13 ft. 4 in. above the pavement, and operated through transformers in the base of the standards.

Worcester.—Proposed New Plant.—After considerable discussion, the City Council has adopted the Electricity Committee's recommendation to purchase additional boiler and other plant, at a cost of £5,200. It was pointed out that the extension would facilitate the linking-up suggestions of the B. of T., and would also lead to economies in working—some £575 per annum—representing more than the capital charges on the new plant. An application for sanction to the additional plant has been made to the Government Department concerned, but so far without success.

TRAMWAY and RAILWAY NOTES.

Blackpool.—The Blackpool, St. Anne's, and Lytham tramway attained its majority on July 11th, the line having been opened on this date in 1896.

Canada.—The employés on the Toronto tramways recently struck work, demanding an increase of 5d. an hour, making 1s. 8d. an hour instead of 1s. 3d.

The strike was settled by the acceptance by the men of an offer of 3d. an hour increase in their wages.

Continental.—Spain.—The formation of a company for the construction and working of electric tramways and railways is, says *La Energia Electrica*, under consideration at Barcelona. The promoters are a Dresden firm, who, however, contemplate raising the capital by local subscriptions. Railway schemes immediately in view are a line from Almeria to Berja, and another from Coin and Ronda to Tolon (Balneario).

The Compania del Tranvia Electrico de Aviles has applied for a concession for the construction of electric tramways from Villalegre to Aviles and San Juan de Nieva.

Switzerland.—A decision which the Administration of the Swiss Federal Railways has come to settles the question which has long hung fire. A water-power station is to be set up on the River Ritom, on the southern slope of the Gothard range, providing a fall of over 800 metres. Three turbines will be installed at first, each of 12,000 H.P.—*L'Industrie Electrique.*

Halifax.—A tramway accident occurred at Ambler Thorne, Queensbury, on Sunday evening last, a Corporation car on the journey to Halifax getting out of control and leaving the rails and overturning; about 30 people were injured.

Heywood.—Alderman Ashworth, referring to the June receipts on the tramways, said if they were maintained at that level for the whole year, they would soon be paying, as they showed an average of 15·66d. per car-mile.

L. & Y. Railway Electrification.—A commencement has been made with the work of conversion of the Bury—Holcombe Brook line of the Lancashire and Yorkshire Railway to the same system of electric traction as that in operation between Manchester and Bury, and it is expected that it will be completed at an early date.

London.—Year's Working of the L.C.C. Tramways.—The annual accounts of the Council's tramways for the year ended March 31st last show total receipts amounting to £2,552,203 and working expenses, including war service allowances, of £1,817,694, leaving a gross surplus of £734,509. Interest, sinking fund, and other charges amounted to £723,167, leaving a net surplus of £11,342, which has been transferred to the renewals fund, which stood on March 31st at £282,978. Previously to this year there have been no payments into this fund since the year 1912-13, except interest on investments and amounts received from the L.U. Tramways, Ltd. The general reserve fund on March 31st last amounted to £72,390. During the year 586,127,976 passengers were carried and 49,478,973 car-miles run, these figures comparing with 515,429,397 passengers and 47,879,675 car-miles in 1915-16. The capital expenditure at March 31st amounted to £13,570,119, and the debt outstanding, less the sinking fund in hand and less £120,216 in respect of the value of surplus land, was £9,141,286. Capital expenditure on obsolete horse lines still to be provided for amounted to £943,740. The tramways system on March 31st, 1917, extended over a total length of 149 street miles, being 144½ miles of electric lines and 4·6 miles of horse lines. The only horse tramway routes not yet electrified are those in Burdett Road and Grove Road, &c., and in Southwark Park Road, &c., and as the services on these tramways have been withdrawn, the system in operation consists entirely of electric tramways. During the year the only work of tramway construction undertaken was the doubling of certain portions of single line in Woolwich.

L.C.C. Revised Tramway Estimates.—The following is a summary of the revised estimated results of the working of the tramways for 1917-18:—

Estimated gross surplus, £739,142; debt charges, &c., £730,814; leaving a net surplus of £8,598 instead of an estimated deficiency of £89,402. The estimates contain provision for £114,300 for war service allowances; but for this special charge, the results of working the tramways for the year would show an estimated surplus of approximately £123,000, notwithstanding the increasing working costs. The estimates contemplate £8,598 being available for addition to the renewals fund in 1917-18. The balance of the fund at March 31st, 1918, is estimated at £200,112, without taking account of the depreciation of investments; the estimated balance of the general reserve fund at March 31st, 1918, is £71,919 on the basis of investments being taken at cost price.

The Highways Committee recommends that application be made for an extension of the time allowed for the construction of certain tramways authorised, which will expire in August, 1918.

The Council has decided that 2d. workmen's tramway tickets shall no longer be available for the return journey or for a single journey by any car and on any route; also that workmen's return tickets shall only be available for return over the section for which they are issued for the first journey; and that workmen's tickets will not be issued to suburban termini by cars leaving the central termini after 7.30 a.m.

Manchester.—Wages.—Sir George Askwith has decided to sit this week to hear the Corporation tramway employés' case for the revision of the recent wages award. Meantime, whilst the other Lancashire tramway authorities are protesting against the award being re-opened at all so soon, the Tramway and Vehicle Workers' Association, with which the Manchester employés are affiliated, takes the view that if the Manchester case is re-opened, those of the employés in the other districts must also be reconsidered, and the executive of the Association is demanding the re-opening of the whole award.

Northampton.—Fares.—The Tramways Committee is recommending the Council to increase the fares on the 1d. sections to 1½d., with a 1d. stage on each section. There was a loss of about £3,000 on the tramways last year, and unless the revenue is supplemented, there is a prospect of a considerably increased deficit on the current year. The institution of 1½d. fares for 1d. fares on one section has, on a three months' trial, led to an average increase of £30 per week in the takings on that section, and if this average is attained on the other sections, it is estimated that the revenue will be increased by £6,000 during the year.

TELEGRAPH and TELEPHONE NOTES.

A Long Telegraph Circuit.—New York maintains daily direct communication with Valparaiso, Chile, a distance of approximately 7,000 miles, over the cables of the Central and South American Telegraph Co. This is probably the longest regularly-worked circuit in the world.—*T. and T. Age.*

Brazil.—A decree has been issued declaring that the wireless telegraph and wireless telephone institutions in the country are exclusively the property of the Federal Government.

Foreign Languages on the Telephone.—The Postmaster-General, in a Parliamentary answer to Sir Henry Dalziel, states that conversations on the telephone in languages of enemy States are prohibited. The use of the languages of Allied countries is not, he thinks, open to objection, and it could not be forbidden without inconvenience to a large number of subjects of Allied States who, at present, are engaged on official work in this country.—*The Times.*

Recruiting at 3,000 Miles.—Lord Northcliffe, in a brief speech from New York to San Francisco, 3,000 miles away, over the long-distance telephone of the American Telephone and Telegraph Co., urged Californian Britishers "to do their bit" in the war. Conversations were held with many long-distance cities, and then the telephone officials switched on the wires which permitted the listeners to hear the Pacific surf at San Francisco and the Atlantic surf at Coney Island simultaneously.—*The Times.*

Wireless Telephony in the U.S. Navy.—A year ago, with the collaboration of the Bell Telephone Companies, a three-day test of communications as under war conditions was carried out by the United States Navy Department, in the course of which communication by wireless telephony was maintained between Washington and a battleship in the Atlantic Ocean. Since then the use of wireless telephony in the Naval Service has been further developed, and the system will be employed by the U.S. Navy in its war operations. Telephonic communication wtih aeroplanes, new wireless methods, and apparatus for detecting the presence of submarines have also been under investigation, and important progress has been made.—*T. and T. Age.*

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—August 22nd. N.S.W. Government Railways and Tramways. Thirty-six induction motors (Specification No. 488). September 19th.—One 225-H.P. synchronous motor (Specification No. 489). Particulars from Electrical Engineer's Office, 61, Hunter Street, Sydney.

Ilford.—July 31st. Electricity Department. Two rotary or motor converters, 4,400 yards E.H.T. cable, 3,600 yards stoneware conduit. See "Official Notices" to-day.

Keighley.—August 3rd. 12,000 tons best slack and small slack coal for Electricity Department. Six-monthly and twelve-monthly period. Mr. H. Webber, Boro' Electrical Engineer.

London.—L.C.C.—The Highways Committee recommends that tenders be invited for 3,880 yards of electric cable for the Tramways Department.

H.M. Office of Works.—July 23rd. Six or twelve months' supply of conduit boxes. Controller of Supplies, King Charles Street, S.W. 1.

CLOSED.

London.—Shoreditch.—The Electricity Committee has received the following tenders for turbo-alternator plant at Whiston Street :—

British Thomson-Houston Co., Ltd.	.. .. ..	£26,518
British Westinghouse Co., Ltd.	(recommended)	26,598
Brush Electrical Engineering Co., Ltd.	.. .. ..	30,250
Fraser & Chalmers, Ltd.	.. ..	26,738
" " alternative	.. .. ..	26,496
Howden & Co., Ltd.	.. ..	27,193
Ateliers de Construction Oerlikon (Swiss)	.. ..	31,815
Parsons & Co., Ltd.	.. ..	25,900
Willans & Robinson, Ltd.	.. ..	26,600

Hammersmith.—The Electricity Committee has received the undermentioned tenders for E.H.T. cable :—

Pirelli-General Electric Co.	.. ..	£176
Macintosh Cable Co.	.. .. .. (recommended)	180
Callender's Cable & Construction Co.	.. ..	204
Western Electric Co.	.. ..	207
Henley's Telegraph Works	.. ..	209
British Insulated & Helsby Cables	.. ..	234

The Baths Committee recommends the acceptance of the tender of Messrs. Rubery, Owen & Co. for a 20-H.P. motor, with circuit-breaker, starter, &c., for £125.

Poplar.—The Electricity Committee recommends the acceptance of the following tenders :—

Switchgear.—British Westinghouse Co., Ltd., £2,641.
Sub-station switchgear.—British Thomson-Houston Co., Ltd., £1,621.
Cables.—Western Electric Co., Ltd., £1,783; Siemens Bros. & Co., Ltd., £2,081.

Londonderry.—The Electricity Committee has accepted the tender of the Western Electric Co., at £2,080, for a new feeder cable.

Newport (Mon.).—Electricity Committee. Recommended tenders for plant for extensions :—

Induced-draught plant.—Musgrave & Co.
Electrical equipment for induced-draught plant.—Brit. Westinghouse Co.
Cooling towers.—Davenport Engineering Co.

Swansea.—T.C. Messrs. Thomas & Evans, at £73 10s., for the installation of electric light in 27 Corporation houses on Trewyddfa Common.

NOTES.

Electric Light Switching.—The results of the fifth of the periodical Batch Exams. conducted in this subject by Messrs. A. P. Lundberg & Sons are given in our advertising pages, and are, to say the least, remarkable. It is only three months since the results of the previous Examination were given in this journal, and though the number of successful competitors then was very good for war time, the present list shows an increase of over 50 per cent. The average person would conclude that everyone who sent in a paper got a certificate. We are informed that this is by no means the case, 20 per cent. of the candidates having in the present instance failed to satisfy the examiner. Those interested in the subject are advised to write to the firm at 477-489, Liverpool Road, London, N.4, for particulars.

Foreign Trade.—The June Figures.—The official returns of imports and exports during last month contain the following electrical and machinery figures :—

	June, 1917.	*Inc. or dec.*	*6 months*, 1917. *Inc. or dec.*
Imports.			
Electrical goods	84,272	— 69,640	— 110,772
Machinery	668,043	—205,564	— 448,282
Exports.			
Electrical goods ...	244,297	—232,657	— 390,228
Machinery	1,618,124	—153,757	+ 854,538

Volunteer Notes.—County of London Volunteer Engineers (Field Companies).—Headquarters, Balderton Street, Oxford Street, W.

Orders for the week, by Lieut.-Colonel C. B. Clay, V.D., commanding :—
Monday, July 23rd.—Technical instruction (searchlight) for No. 3 Company, Right Half Company, Regency Street. Drill, No. 3 Company, Left Half Company. Signalling Class. Recruits' Drill, 6.30.
Tuesday, July 24th.—Lecture, 6.30. Physical drill and bayonet fighting, 7.30.
Wednesday, July 25th.—Drill and elementary bridge construction No. 1 Company, Right Half Company.
Thursday, July 26th.—Drill and elementary bridge construction No. 2 Company, Right Half Company. Ambulance Class, 6.30. Signalling Class.
Friday, July 27th.—Technical instruction (searchlight) for No. 3 Company, Left Half Company, at Regency Street. Drill, No. 3 Company, Right Half Company. Recruits' Drill, 6.30.
Saturday, July 28th. Commandant's Parade, 3 p.m. Uniform, for route march. Fall in at Golder's Green Station.

Macleod Yearsley, *Company Commander and Adjutant.*

Iron Wire for Rural Transmission.—The Connecticut Public Utilities Commission has agreed to the Central Connecticut Power and Light Co. using galvanised iron wire for H.T. transmission on certain rural lines, on account of the high price of copper. It is proposed to use double-galvanised BB grade No. 6 iron wire, on poles spaced 250 ft. apart, sagging the wire to give a factor of safety of 2 with class B loading, viz., ½ in. coating of sleet on the wire and a wind pressure equalling 8 lb. per sq. ft. of exposed surface of wire and sleet, at a temperature of 0° F. The iron wire is to be used where voltage drop will be inappreciable, and will be replaced with copper if it deteriorates so as to be unsafe.

The Fixation of Nitrogen.—Mr. Baker, U.S. Secretary for War, announces that plants for the production of nitrates from atmospheric nitrogen will be constructed immediately, at a cost of about four million dollars. He states that water power will not be utilised, the process to be used being "a modification of processes previously known."

Inquiries.—Makers of spare parts for "A.E.G." motors are asked for.

Hospital Installation.—The Duke of Portland has offered an electrical installation for the treatment of paralysis, rheumatism, and other suitable maladies to the Mansfield and District Hospital.

Marylebone Electricity Department and the Electrical Trades Union.—The Marylebone B.C. Electricity Committee reports having considered a communication from the London District Secretary, Electrical Trades Union, 70, Gray's Inn Road, E.C., forwarding working rules for power and sub-station engineers, and asking whether the Council is willing to conform to them, and pay rates of wages and observe conditions of labour as appear therein; and stating that in the event of the Council refusing to agree to the rates of pay and conditions of labour laid down in the working rules, the Trade Union Committee will have to name the Council to appear before the Committee on Production to hear the claim of the Union to make their conditions apply to the men in the Council's employ. The Electricity Committee has informed the secretary of the Electrical Trades Union that it has recently increased the wages of the employés of the department, and has come to an agreement with the representatives of the men, and is not prepared to reopen the question.

Parliamentary.—Royal Assent.—The following Acts have received the Royal Assent :—

Trade Union Amalgamation Act, 1917.
Nottinghamshire and Derbyshire Tramways Act, 1917.
Lancashire Power Construction Co., Ltd., Act, 1917.

Holidays on the Clyde.—Shipyards, engineering shops, and other works in Glasgow and on Clydeside closed, on July 12th, for 10 days' holiday.—*Times.*

National Insurance (Unemployment) Acts, 1911 to 1916.—Contributions are payable in respect of :—

2,352 X. Apprentices over 16 years of age employed wholly or mainly by way of manual labour elsewhere than in Scotland in trades set out in Schedule 1 of the National Insurance (Part II) (Munition Workers) Act, 1916, or in munitions work, and who are bound by agreements which are not under seal and which do not purport to have been sealed.

2,353. Apprentices over 16 years of age employed wholly or mainly by way of manual labour elsewhere than in Scotland in trades set out in Schedule 6 of the National Insurance Act, 1911 (Unemployment Insurance), and who are bound by agreements which are not under seal and which do not purport to have been sealed.

2,354 X. Workmen engaged in the manufacture of telephone switchboards for use in war.

2,357. Workmen engaged in the repair of accumulators used in connection with electrical machinery in buildings or ships, including cleaning sediment from the cells. (Application 496.)

B. of T. Coal Transport Reorganisation Scheme: Special Fuel.—In connection with the above scheme, the Controller of Coal Mines is considering the requirements of steam raisers in regard to supplies of special coal fuel. Forms have been sent out to steam raisers throughout the country asking for information in regard to the class of coal used, consumption, &c. A considerable number of the forms sent out have not been returned, and steam raisers who have received such forms should note that their requirements in the way of special fuels cannot be considered in the absence of the information called for by the forms, which should be filled in and dispatched to the Controller of Coal Mines immediately. In cases where steam raisers have not received forms, it is desirable that they should apply at once to the Controller of Coal Mines, 8, Richmond Terrace, Whitehall, London, S.W. 1.

Synchronous Signalling.—In a letter to *Nature* Prof. Joly, of Trinity College, Dublin, draws attention to a notice recently issued to mariners by the Board of Trade, in which the principle of synchronous signalling is applied for the first time to the determination of distance at sea. The notice states that on the Fire Island lightship, at the approach to New York Harbour, a combined radio and submerged sound signalling system has been installed, for use more especially in thick weather. The range of the apparatus is limited to that of the submarine bell receiving equipment, *i.e.*, six or seven miles. The submarine bell strikes six strokes, pause, then eight strokes once every 38 seconds. Beginning shortly after the first stroke of the six, about ½ second, the ship emits a series of radio signals. In order to determine the distance of a ship from the lightship it is necessary to count each of these radio dots until the *first stroke of the six submarine signals is received*. The number of dots thus determined gives the distance in half sea miles from the lightship. Example:—Eleven radio dots are received before the first stroke of the bell; the distance is 11/2 or 5½ miles. The most convenient method of receiving these signals is to have one receiver connected to the radio and the other receiver connected to the submarine bell detector, thereby connecting one ear to radio signals and the other to submarine signals. The particular mode of applying synchronous signals above described, says Prof. Joly, enables the mariner to dispense with the use of stop-watch or chronometer. If a wireless and a submarine signal be started together, the latter lags 1·2 seconds for each mile travelled, or for each half mile the lag is 0·6 second. Hence if the instantaneous signal is repeated every 0·6 second, the first of these being emitted 0·6 second after the first submarine signal, the mariner at half-mile distance from the shore station gets both initial signals together. At one sea mile he gets the first submarine signal along with the second radio dot; at one and a half sea miles the third radio dot coincides with the first submarine bell stroke. Hence the rule: Divide by 2 to find the distance in sea miles.

The application of synchronous signalling to avoiding collision at sea is perfectly simple, and the step now taken should lead to its careful consideration and trial. In this case a vessel A, when overtaken by thick weather, emits synchronous signals, say, every two minutes. Another ship, B, hearing these, not only learns of the presence of A, but also gets her distance at once. B is also signalling, so that like information reaches A. Each ship now signals her course and speed. The navigating officers on A and B then read on an instrument of simple construction (1) the rate at which the ships will be nearing one another, and (2) the mutual bearings of the two ships—*if collision is threatened*. And now after two minutes each officer, on receiving the second synchronous signal of the other ship, is able to say whether danger threatens him or not. For if this second signal tells him that the ships have approached each other by a certain distance during the two minutes (a distance read directly on the "Collision Predictor") there is danger of collision. If the distance covered is less than this (it cannot be greater), there is safety. The third synchronous signal may be used to confirm the result.

Buyers—Beware!—Under this title the *Revue Générale de l'Electricité* prints a warning in connection with an advertisement appearing in the *E.T.Z.* as follows (translation):—

SWITZERLAND.

A Swiss electrical firm with large capital, having the best export connections, will resume after the war the export as well as the improvement [the *Revue* suggests "disguise"] of German electrotechnical products. First class references will be supplied on request. Address inquiries to Alfred R—— Hamburg . . . (for obvious reasons we suppress the address).

Our contemporary remarks that we have amongst neutrals good and loyal friends, but there are also within their borders agents who will seize every opportunity to make money, though it be stained with the blood of thousands of human beings. We have been taught to be cautious, and we echo the warning—after-war buyers, be on your guard!

The A.S.E.—For the post of assistant general secretary of the Amalgamated Society of Engineers, Mr. John E. Arthur, of Lambeth, has been elected.—*Daily Chronicle.*

Excess Profits Duty.—There was a lengthy discussion in the House of Commons on Monday, when the Finance Bill was under consideration. Mr. G. Terrell moved a new clause on behalf of manufactures, most of which had come into existence since the outbreak of war, the object of the clause being to protect manufacturers so that when a tax is levied on profits it is real net profits that are taxed, and not something more than profits. All manufacturers should be allowed the depreciation which a prudent trader desirous of maintaining his trade or business in a high state of efficiency considered necessary. The Government should encourage manufacturers to equip their works in the most up-to-date fashion. The amendment was negatived after the Chancellor of the Exchequer had reminded the House of the protection which firms now had with regard to depreciation, and that they could go in every case with a direct appeal to the Referee if it was considered that a grievance existed. The proposed clause would have meant that the whole excess profits tax would end so far as manufacturers were concerned. Sir J. Harmood Banner moved a new clause with respect to the valuation of stocks, the effect of which, he said, would be to stereotype the basis of values of stocks during the period of excess profits duty. Throughout the country an enormous amount of stock held by manufacturers had been entered at cost; now the Government required the stock to be taken at market price, which would mean that they would have to pay on paper values which might never be realised. After some considerable discussion, Mr. Bonar Law announced that, in order to meet the views of members, the Government would put two years in the White Paper as the period to be allowed after the termination of the war in which to ascertain by actual realisation the value of the stock appearing in the account at the end of the last accounting period, and an allowance would be made from the profits of that period for any difference between the valuation and the sum realised. The period previously proposed was a fixed period of a year from the termination of the war, for all businesses. Sir J. Harmood Banner then withdrew his clause.

Electric Power Supply.—General Croft, in the House of Commons, on July 11th, asked the President of the Board of Trade whether, in view of his having promised to increase the representation of local authorities owning electricity undertakings on the Committee of Electric Supply, he would consider appointing a member to represent the provincial electric supply companies working under Provisional Orders and subject to purchase.

Sir Albert Stanley replied: I am of opinion that the Electric Power Supply Committee as now constituted is sufficiently representative of all bodies owning electricity undertakings, including those described, and I am not prepared to make any further additions to it.

Mr. Gilbert asked the President of the Board of Trade if he would state how many members of the Departmental Committee on Electric Power Supply were directors of electric power companies; and if he would state the qualifications of the last three members appointed to represent the interests of municipal electrical undertakings.

Sir Albert Stanley replied: There are three members of the Committee who are directors of electric power supply companies. Of the three members referred to in the latter part of my hon. friend's question, Mr. Harold Dickinson is the electrical engineer to the Corporation of Liverpool, and was nominated to serve on the Committee by the Association of Municipal Corporations. Mr. Vesey Knox, K.C., has acted as counsel for many urban district councils owning electricity undertakings, and was nominated by the Urban District Councils' Association. Mr. W. B. Smith is a member of the Glasgow Town Council, who own the largest municipal electricity undertaking in Scotland, and was nominated by my right hon. friend the Secretary for Scotland, on the recommendation of the Lord Provost of Glasgow.

Mr. Gilbert asked the President if he would be prepared to consider whether the London undertakings should also have a representative on the Committee.

Sir A. Stanley: I should like notice of that.—*Financial News.*

In the House of Commons, General Croft asked the President of the Board of Trade whether, having regard to the fact that the latest additions to the Board of Trade Departmental Committee on the Supply of Electricity were all representatives of municipal interests, he would reconsider his determination to exclude representatives of electric supply companies which were liable to purchase, and whether his attention had been called to the fact that these companies, subject to purchase, represented a capital of £25,000,000 sterling.

In a written reply, Mr. Roberts (Secretary) said: The Committee already includes representatives of the companies described, and the President does not see any reason to alter his decision not to make any further additions to the Committee.—*Financial Times.*

Report of the Electrical Trades Committee.—In the House of Commons, General Croft asked the President of the Board of Trade whether the reports recently made by the Electrical Trades Committee and the Coal Conservation Sub-Committee on Electric Supply had been published, and, if not, whether they would be published at an early date. Mr. Roberts said that the Government had decided that it is not desirable to publish at present the reports of Committees on the various aspects of industrial and commercial reconstruction. All the recommendations of these Committees were receiving earnest consideration.

Electrically-heated Moulding Presses.—The Westinghouse Electric and Manufacturing Co., of East Pittsburgh, Pa., has adopted electric heating for 23 presses used in the manufacture of moulded composition material. These presses were formerly heated by steam, but a trial of an electrically-heated press proved so satisfactory that the entire set of presses in the company's moulded-insulation department is now being modified for equipping with electric heaters.

A series of tests made on one of the presses shows that from one to 1¼ hours are required to heat the plates, starting cold, and that 1,800 watts is required to keep the press hot while in steady use for work requiring a temperature of 190° C.

Rats!—A City shop employé, fined 20s. for not properly shading lights in the premises, explained that they were properly switched off when the shop was closed for the night, and said that they must have been switched on again by a rat.—*The Times.*

Scientific Research.—The trustees of the Beit Fellowships for Scientific Research have recently elected Mr. Leslie Hartshorn to a Fellowship. He will carry out his research in the Imperial College at South Kensington.

Electricity Works Employes and Exemption.—The borough electrical engineer of Southend has reported to his Committee in regard to the applications made to the local Tribunal for the exemption of five men whose services the Committee had considered essential, that, subsequent to the applications being made, the system of exemption of men employed in undertakings certified under the Munitions of War Act (of which the electricity undertaking is one) had been revised, and that in accordance with the new system applications had been made to the Munitions Area Recruiting Officer by the men referred to, for protection certificates exempting them from military service so long as such certificates should remain in force, and that the certificates applied for had been granted. He further reported that one of the certificates had since been withdrawn. The town clerk was directed to communicate with the Munitions Area Recruiting Officer with the object of arranging a conference between the chairman, the electrical engineer, the local Military Representative and the officer himself with respect to the men employed in the electricity undertaking whose services the Committee regards as essential to be retained.

Liberty Bonds.—Up to June 14th employés of the Central Group of Bell Telephone Companies subscribed for $652,850 in Liberty Bonds. Chicago Telephone Co.'s employés took $370,250, 5,891 subscriptions being for $50. Commonwealth Edison Co. employés to the number of 6,043 subscribed for $506,600.—*Elec. Rev. and Western Electrician.*

Engineering Wages: Further Advance.—An award has been issued by the Committee on Production giving a further advance of wages to all grades of workmen employed by members of the Engineering Employers' Federation. The award is given in pursuance of an agreement between the Federation and 46 Trade Unions connected with the engineering and foundry trades, under the terms of which the Committee on Production may be called upon at intervals of four months (*i.e.*, February, June, and October) to consider what alteration in wages is warranted by the abnormal conditions due to the war. The awards now issued give a further advance of 3s. per week, making the aggregate increase on pre-war rates 15s. per week. An advance of 1s. 6d. per week is given to boys and youths.

Scottish Electricians' Wages.—Mr. James M. Davies, jun., secretary of the Electrical Contractors' Association of Scotland, states that the general effect of the wages award is that the employés in the Glasgow district receive an advance of 1½d. per hour as from the beginning of June. The employés have already received more than the 7s. minimum advance, in two advances of 1d. and ½d. respectively (making for the 54 hours' week, 7s. 10½d.).

Higher Education.—The Society of Chemical Industry held its annual meeting, in Birmingham, on Wednesday and Thursday, concluding to-day, and we will refer to a number of matters of electrical interest in our next issue. In his presidential address, on Wednesday, Dr. Charles Carpenter referred to the necessity for bringing our governing classes more into contact with the working classes—which make up the bulk of the population—in early training, if they were thoroughly to understand their outlook on life. In coming into contact with men holding important positions, he had been struck by the remarkable fact that, although they had been fully qualified to deal with big businesses and organisations, they had not the least idea how to manage and deal with workers. The reason was that their early training gave no opportunity for getting into close and personal contact with them.

He suggested that a boy, on reaching the age of 16, should commence, either at the desk or in the factory, with compulsory attendance at continuation schools. After two or three years he would, if showing himself to possess the necessary ability, be fit for entrance to the university. At the same time, it should not be left to chance to determine the path which the boy followed after leaving school. If the teaching authority had properly looked after him, it should be easy to divine the pupil's leanings, and direct his course in accordance with them. As a preliminary step towards this, the first principles of experimental science should be taught compulsorily at the primary schools. In this matter, the community required, and was entitled to have, the assistance of the State. Our educational system needed alteration at the foundation. In his opinion, a boy was old enough to learn science when he was old enough to learn history and geography. Incidentally, Dr. Carpenter urged the importance of the interdependence of the engineer and the chemist, and regarded it as imperative that they should get into double harness as soon as possible.

Prohibited Exports.—The Supplement to the *Board of Trade Journal* of July 19th contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported from British India, Australia, Canada, New Zealand, South Africa, Newfoundland, Egypt, Cyprus, and Ceylon.

Appointments Vacant.—Engineer-in-charge (55s.) and senior switchboard attendant (40s.), for the Darlington Corporation Electricity Department; shift engineer (£115) and engine fitter and turner, for the Dover Corporation Electricity Works. See our advertisement pages to-day.

Russian Electro-Technical Institute.—The Ministry of Trade and Industry has prepared a project for the transfer of the Electro-Technical Institute from the control of the Ministry of the Interior to that of the Ministry of Trade and Industry. The Department proposes the reform of the basis of the professional educational side of the Institute, in order to fit it better to meet the greater demands on it, and the requirements of the electro-technical industry. The Minister of Posts and Telegraphs protests against the move, as the original home of the Institute was in this Department.

Steel-cored Aluminium Wire.—The employment of this material is described in an article on the supply of electricity to Pomona, a "small town" of 600 inhabitants, or what we should call a village, in the *Electrical World* of May 5th. Power is transmitted from a station at Ottawa (Kan.), 11 miles (17·7 km.) distant; lattice steel poles are used, carrying No. 4 B. and S. stranded steel-cored aluminium wire, with a sag of 17 in. (432 mm.) at 70° F. The pressure is 6,600 volts, single-phase, reduced to 220—110 volts for distribution, the total power provided for being 15 KW. The transmission-line poles are 250 ft. (76·2 m.) apart; on the distribution lines, consisting of Nos. 0, 2, 4, and 6 B. and S. gauge wires, about half this spacing was adopted. The installation cost in all $12,252, and the consumers number 110. The price is 6d. per KW.-hour, and energy is purchased from the generating station at Ottawa at 1½d. per KW.-hour. The average supply is 2,089 KW.-hours per month, costing in all $62·68.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—The Bradford Corporation Tramways Committee has increased the salary of Mr. J. W. DAWSON, assistant electrical engineer in the tramway department, from £295 to £325 per annum.

Gravesend T.C. has disagreed with a motion to grant a war bonus of £50 a year to the electrical engineer, Mr. MCINNES, and has passed an amendment asking Mr. McInnes not to press for any increase until after the war.

Colchester T.C. has, having regard to the special services rendered during the past two and a half years, increased the salary of the electrical engineer, Mr. FRISBY, by £50 a year as from June 1st.

Mr. D. H. C. LYE, who served his articles at the Folkestone electricity supply works, has been granted a commission in the R.F.C.

General.—The wedding took place on July 5th, at Holy Trinity Church, Hoghton, of Lieutenant EGERTON JOHN WARD, A.M.I.E.E., The Royal Irish Regiment, to Olive Mary Langton, second daughter of the Rev. T. L. Webster and Mrs. Webster, of Hoghton Vicarage, Preston, Lancs.

Mr. LORENZO W. MIGOTTI, who for the past nine years has been electrical engineer to the Bahia Blanca North-Western Railway, and manager of the South American Light and Power Co., and who was formerly with the Underground Railways of London, has accepted the post of chief engineer to the Electric Supply Co., of Rosario de Santa Fé, Argentine Republic.

The Hon. GILBERT JOHNSTONE having resigned from the L.C.C. Special Committee on London Electricity Committee, the Committee recommends that Mr. F. C. HARRISON be appointed to fill the vacancy.

In commemoration of the completion of the 21st year of the working of the County of London Electric Supply Co., Ltd., the company presented silver match-boxes to members of the staff, and gold medallions to the chief officers. These were inscribed as follows:—"To commemorate the 21st year of working 5,000 KW. per annum in applications, and 1,000,000 units sold per week. 1916." The directors and chief officers of the company also presented to the chairman, Mr. J. B. BRAITHWAITE, a rose bowl and salver in commemoration of the above and of his association with the company since its formation.

On Monday last, at a meeting of the Manchester Education Committee, Mr. GEORGE GERALD STONEY, B.A.I., F.R.S., &c., was recommended for appointment as Professor of Mechanical Engineering in the Manchester School of Technology.

Our Chicago namesake says that Mr. SAMUEL INSULL, president of the Commonwealth Edison Co., Chicago, Ill., has been given the degree of Doctor of Science by the Union College, of Schenectady, N.Y., in recognition of labours in the development of electrical science.

Roll of Honour.—Lieutenant CYRIL STREET, R.F.C., killed in action, was trained as an electrical engineer at Broadheath, Manchester.

Sergeant F. C. Platt, R.E., who has been awarded the Military Medal for bravery in the field, was employed as an electrical engineer by the Wolverhampton Corporation.

Mr. A. J. Collins, of Scorton, a wireless telegraphist on one of H.M. ships, has been killed at sea, his vessel being torpedoed or mined. He was 30 years of age, and was recently awarded the Distinguished Service Medal.

Lieutenant Frank S. Scarr, Australian Engineers, who has fallen in action near Bullecourt, was formerly on the staff at Enfield, N., of the Ediswan Co. He was 38 years of age, joined the ranks, and saw service in Gallipoli. For his services in that theatre of the war he was complimented by Sir Ian Hamilton, and was given his commission on the field.

Able Seaman D. Colmar, R.N., who has died at Haslar Hospital at the age of 37 years, was prior to the war manager's assistant at the Totnes electric light works.

Private Arthur Holgate, York and Lancaster Regiment, killed in action, enlisted from the Doncaster Corporation tramway staff.

Albert Woodcock, S.P.O. Torpedo Boat Service, reported killed, was formerly employed at the Bradford Corporation electricity works.

Private J. T. Hall, who was in the turbine department at Wheatley Hill Colliery (Co. Durham) has been killed in action.

Private J. Charnock, King's (Liverpool Regiment), formerly reported missing, and now officially reported killed, was employed by Messrs. Dick, Kerr & Co., Ltd., Preston. Lance-Corporal Hesketh, Loyal North Lancashire Regiment, killed in action, was also employed by the same firm.

We desire to tender to Dr. and Mrs. Ferranti on our own behalf, and we are sure also on behalf of a host of sympathisers in the electrical profession, our sincere condolences with them on the death of their eldest son, Major Basil de Ferranti, M.C., R.G.A., from wounds received in action on July 12th. That Major Ferranti was wounded was announced in our last issue, but we regret that he has now to be reckoned among the increasing number of electrical men to whom it has fallen to make the supreme sacrifice.

J. W. Wood, an employé of the Marylebone electricity department, at present serving as a sergeant in the R.A.M.C. in France, who was awarded the D.C.M. for services in the field last year, has now been awarded the Croix de Guerre by the French Government in recognition of work done during the past 12 months.

Lance-Corporal John Armstrong, R.E., who has been killed in action, was engaged in the electrical department of the Calico Printers' Association, Ltd., Manchester.

Bombardier E. Wade, R.G.A., wounded and in hospital abroad, was engaged in the British Westinghouse Works at Trafford Park.

Private Allway, Gloucester Regiment (T.F.), who has died from wounds, was employed at the Bristol Corporation electricity works.

Obituary.—Mr. Frank Patchett.—We regret to record the death of Mr. Frank Patchett, J.P., of Halifax, at the age of 69 years. He was the owner of the business conducted as George Patchett & Sons, wire manufacturers, with which firm was incorporated several years ago the Northern Electric Wire & Cable Manufacturing Co. He was one of the oldest magistrates for Halifax.

CITY NOTES.

General Electric Co., Ltd.

Presiding at the annual meeting, on Tuesday, Mr. H. Hirst said that the total net profit had increased by about £70,000—£30,000 on trading account and £40,000 revenue from investments. The investment account, which had shown a steady yield of about 10 per cent., had increased by, roughly, £350,000, and the net revenue from this source had grown correspondingly. This was mainly due to the acquisition of shares in the Osram-Robertson Lamp Works, Ltd., of which they were only part owners in the past, although they always managed the factory, and absorbed its entire output. The scarcity of raw materials and skilled labour, and the uncertainty of the patent situation, as well as certain war work, which interfered with the standard output, made it more than likely that the revenue from this investment might not be quite up to this year's level in the near future. They had, however, planned extensions, acquired improved methods of manufacture, and made arrangements for the starting of a research laboratory, so that as soon as they could go full-speed ahead they would again reap the fullest benefit from this bold venture. It was desirable that they should have plenty of cash at disposal. Raw material prices were still soaring at a great height. To-day the same amount of business as in pre-war time necessitated the employment of nearly double the amount of money; on the other hand, credit was considerably shorter, purchasing was more irregular through difficulties of transport, and funds must therefore be at disposal at a moment's notice in order to secure materials when they were to be had. This was sufficient explanation of the bank loan. With reference to the additions to reserve, they had always striven to strengthen and develop the company so as to make it one of the strongest electrical concerns in the country. They had therefore put to a contingency account every year a certain sum which should, approximately, cover any possible losses. By that means the investments were always kept at par value. In the course of time, however, the allied and subsidiary companies developed and made profits, which were used in the first instance to wipe out previous losses or establishment charges, and as soon as this was accomplished the reserves originally allotted to them became free. The £100,000 transferred was an amount freed from such accounts, and also from contingencies in connection with contracts, which fortunately did not arise. In making this transfer they had not departed from their usual conservative policy. He hoped that the ordinary shareholders would approve their refunding this year the income-tax to preference shareholders by way of a special bonus. The ordinary shareholders were reaping the full benefit of the prosperity of the company, not only by an increased dividend, but also by the appreciation of the value of their shares. The directors felt that they had been just to the demands of labour and employés, and thus the only class suffering under present conditions was the preference shareholder, who had a fixed rate of income, with an increasing rate of income-tax. The preference shareholders numbered about 3,000, mostly small investors, many of whom probably felt the stress of the times very much. Some ordinary shareholders thought that the results of the year warranted a bigger dividend. He appealed to them to be satisfied with their proposal. The present war would change many things—perhaps everything. Nothing would be quite as it was before the war, but of all the changes that would alter industry in this country, the electrical industry would undergo the most drastic transformation. Electrical plant in the country at the present moment was run at high pressure to a premature death. Under present conditions none but the most important plant could be replaced, and the replacement and re-organisation necessary after the war would be a tremendous task for the existing electrical companies, which had yet to make good a deficiency in output to cover the demand, which in pre-war time was supplied by importation. War had taught this country the necessity of home production. Many industries on which this country relied would have to modernise their methods and rejuvenate themselves. Electric power, heat and light were primary essentials in the carrying out of such a programme. The depletion of rolling stock in the country would have to be made good, and railway electrification on a large scale had suddenly appeared within the realm of immediate practical politics, for which many of them must prepare. Greater efficiency and economy throughout this country occupied the mind, not only of industrialists, but also of Government departments. They heard much nowadays of barbaric waste of coal, and only the other day the Controller of Coal Mines had to issue an Order to save labour, transport, and rolling stock, which divided the country into areas within which coal from certain districts could only be circulated and used. He was convinced that the extraction of by-products from coal would have to be treated from a national point of view. He was convinced of the necessity for the creation of large generating stations in some 15 to 20 centres throughout the Kingdom, so that instead of coal being transported to big power units, big power units would be transported to the coalfields, and, after the extraction of by-products, electric current or gas, or both, would be transmitted to towns and industrial undertakings to supply power, light, and heat through cables and pipes, and the necessity for the conveyance of coal by rolling stock would be reduced to a small proportion. Many industries, especially certain chemical industries, above all the production of fertilisers, would thus become practicable in this country, whereas in the past they were relegated only to countries where water-power was available. Power, the foundation of all modern industry, would then, thanks to our natural resources, be produced in this country as cheaply, if not more cheaply, than in any other part of the globe. He had said nothing of the electrical requirements of the oversea dominions, and of poor Belgium and many of the Allies, whose wants in the past had been largely supplied by enemy countries. He had, however, said sufficient to indicate a few aspects of the big task expected from the electrical industry, and the "G.E.C." meant to take its proper part in this evolution and in these developments. It was for that reason that they were not at present suggesting a higher dividend, but preferred that the company should be strong enough to command any capital required, and to run certain risks connected with such new enterprises without prejudice to its future prosperity. Income-tax and excess profits must be paid, and the directors could only appeal to the ordinary shareholders for an altruistic policy to attain these great ends. He was convinced that some day, perhaps not too distant, they would reap very tangible results from this present self-denial. Their capital, and the skill of the directors and staff would, however, not alone bring about these changes, which were so essential for the national benefit. They must above all have the co-operation of Labour. The relationship between the management of their company and Labour throughout their history had been good—as good as that of any concern in the country. Yet there had been in the past occasional periods of tension

and stress which, in spite of goodwill on both sides, had been difficult to overcome. Present conditions had brought about better vision. The conditions of the country, and more particularly the outlook after the war, had made in clear to all that mutual understanding was essential in the national interests. The leaders of Industry and Labour had at last met to exchange views; they were comparing notes and formulating ideas, even programmes, which should go far to remove a great many of the past difficulties. Let them hope before the war was finished a means or machinery might be found which would solve any future difficulties which were bound to crop up from time to time without resort to strife. From personal experience gained during the past year, he knew that the desire for harmonious working existed, and had been fostered by genuine patriotism on the part of both employers and employés. Much patience was, however, still required to make these ideas effective and to bring them to fruition. For two or three generations, both classes had been set against each other, mistrust and prejudice had been preached, and it required not only goodwill and intention, but also a period of probation and experiment of the most varied kind to bring home to each side a conviction of the sincerity of the other. He was sorry to say that the list of those of their staff and workpeople who had given their lives in the great cause had grown to 119; 209 had been wounded, six were prisoners of war, and 10 were missing. Amongst the honours awarded to their men were two Military Crosses, two Distinguished Conduct Medals, eight Military Medals, and two Meritorious Service Medals.

Brazilian Traction, Light, and Power Co.

The report for 1916 shows that after deducting general and legal expenses, administration charges and interest, $344,830, there is left $5,674,642. Dividends on the preference and ordinary shares absorbed $4,851,488, leaving $823,154. The reduction in the surplus of net revenue for the last two years, attributable to the decline in exchange from the rates prevailing for several years before the war, is approximately $3,000,000 for 1915 and $3,300,000 in 1916. Since the middle of April the exchange value of the milreis has advanced from 12d. to 13⅜d. on June 13th. If this rate is maintained the net revenue should show a very substantial increase. The surplus profits of the subsidiary companies and the Brazilian Traction since their incorporation, which at December 31st, 1915, remained undistributed in dividends, amounted to $14,773,244. Of this $4,660,000 has been allocated to special reserve accounts for renewals, contingencies, &c. A further sum of $1,500,000 has been applied for payment of the sinking fund instalments of the first mortgage bonds of the Rio de Janeiro Tramway, Light & Power Co., leaving $8,613,244 unappropriated on the books of the companies, which sum has been invested in the development of the enterprises of the subsidiary companies. Out of this surplus the total amount allocated to special funds is $4,6 0,000.

Lancashire Power Construction Co., Ltd.

The trading profit of the Lancashire Electric Power Co. for 1916 was £38,710, plus £1,128 interest on hire-purchase plants, &c., making £39,839, as against £32,843 for 1915. £2,064 brought forward is added. Debenture interest has required £4,500, there has been put to reserve £15,000, a dividend of 3 per cent. on the shares absorbs £14,700, and £7,703 is to be carried forward. The following figures show the development of the Parliamentary company's business for the past three years:—

	1914.	1915.	1916.
Units generated	32,157,185	35,768,064	40,842,652
Max. load in kw.	10,210	10,740	11,900
H.P. connected	27,018	29,000	30,600
Receipts	£65,438	£72,395	£97,964
Expenditure	£35,472	£40,160	£59,254
Profit on trading	£30,961	£32,235	£38,710

The revenue account of the Lancashire Power Construction Co., Ltd., shows that the total interest, dividend, and other receipts for the year amounted to £19,205, and after deducting therefrom debenture interest, trustees' fees, and general charges payable, £15,468, the available balance is £3,735, which is to be carried to reserve. A Bill to re-arrange the capital of the company and for other purposes, has received the Royal Assent, and the re-arrangement will now be proceeded with. Annual meeting: July 26th.

New Issue.—The "Manchester Guardian" states that, in order to complete extensions at their works at Middlewich, the Electro-Bleach & By-products Co. are issuing the balance of their authorised share capital at par—namely, 7,956 preference and 8,000 ordinary shares. Treasury sanction has been obtained. The company, which took over the properties of the old Electrolytic Alkali Co., began manufacturing in January, 1915, and in consequence of the demands on the chemical industry have been very busy since. For 1915 the dividend was at the rate of 7 per cent., the profit being £25,574, and out of this £4,000 was placed to reserve. Owing to the pressure on the Ministry of Munitions and the consequent delay in adjusting the duties payable by the company as explained at the annual meeting last month, the accounts for 1916 have not yet been published, and the directors have repeated the 7 per cent. dividend.

British Thomson-Houston Co., Ltd.—Profit for 1916, after deducting expenses other than interest, £359,364, plus £73,359 brought forward, less £70,000 for excess profit duty and increased depreciation for 1915. Reserve *re* raw materials at December, 1915, not required and written back £25,000. Interest on loans and debentures £70,000, appropriated for depreciations £153,700, leaving £163,923 to carry forward, subject to deduction of munitions levy for 1916. Mr. E. Thurnaeur retires from the board.

Mather & Platt, Ltd.—Interim dividend on the ordinary shares, 5 per cent. for the half-year, less income-tax.

St. James' & Pall Mall Electric Light Co., Ltd.—Interim dividend at the rate of 7 per cent. per annum on the ordinary shares.

Sao Paulo Tramway, Light & Power Co.—Dividend 10 per cent., to reserve $1,350,000, to depreciation and renewals $250,000, carry forward $32,757.

Rio de Janeiro Tramway, Light & Power Co.—Dividends 5 per cent., to general reserve $1,750,000, to depreciation and renewals $750,000, carry forward $56,542.

Kaministiquia Power Co.—Quarterly dividend $1¾ per share (7 per cent. per annum).

West African Telegraph Co., Ltd.—The accounts show £12,720 available, as compared with £25,347 for 1915. £2,000 (against £13,000 has been transferred to reserve, and a further dividend of 2 per cent. has been paid, making the usual distribution of 4 per cent. for the year, free of tax.

W. & T. Avery, Ltd.—Further dividend, 10 per cent., less tax, making a total of 12½ per cent. for the year, placing £13,000 to reserve, and carrying forward £12,564.

Hadfields, Ltd.—Interim dividend, 1s. per share, free of tax, on the ordinary shares.

Metropolitan Electric Supply Co., Ltd.—Interim dividend, 2 per cent. per annum (1s. per share) on ordinary shares.

Lima Light, Power & Tramways Co.—Dividend, 1 per cent.

Nairobi Electric Power & Lighting Co., Ltd.—Interim dividend at the rate of 6 per cent. per annum for the half-year ended June, 1917.

Singapore Electric Tramways Co., Ltd.—Interim dividend, 5 per cent.

STOCKS AND SHARES.

Tuesday Evening.

Rising Consols are as clear an index as can be desired of the investor's frame of mind, and Consols just now are what the Stock Exchange calls a good market. The strength of the stock finds apt reflection in the other investment departments, and sound industrials are particularly in favour. Stock Exchange jobbers have become very cautious in selling shares they have not got, because time after time their expectations of buying back the shares have been disappointed, holders declining to sell at prices they would have deemed tempting six months ago.

Therefore quotations respond with alacrity to the growing pressure to buy. Metropolitan Electric preference are ¼ up. The company has this week declared an interim dividend of 2 per cent. on its ordinary shares, the same rate as last July's. Other interim dividends will probably follow the same sort of line, and repeat their last year's interim declarations. City Lights are ¼ up at 12½, and County ordinary hardened to 11. General Electric ordinary at 16½ are the fraction to the good. British Westinghouse preference show strength at 2 9/16, this being 3/16 up. Edmundsons at 2½ are ¼ better on the report; the preference dividend is secured, though net profits at £12,300 are about a thousand pounds down compared with 1915-1916.

County of Durham Electric 5 per cent. debenture stock has been removed from the pages of the Stock Exchange Official List by reason of the infrequency of dealings, the last recorded bargain having been at 94½ on October 17th, 1910.

The Home Railway dividend season begins this week, and there is mild curiosity as to how the companies will show up. It is taken more or less for granted, however, that the forthcoming interim dividends will be, like those of the electric lighting companies, the same as the 1916 levels. Most of the prices fairly well maintain their recent spurts, but Districts, and Metropolitans have both lost ¼, and the price of the latter looks high enough, in the light of its one per cent. dividend. Districts, on the other hand, having received no distribution for the past 34 years, are not handicapped in the same way, their vogue being due to "possibilities"—always more attractive than a meagre dividend. Underground Incomes at 84 are ½ better on the week.

Mexican news is said to be much more favourable, and while the industrials have not moved, Mexican Government and Railway issues are up, this usually being precursory to a stiffening of the others. A substantial rise in Brazilians

followed upon the resumption of cash payments of the Republic's coupons due this week. Brazilian Tractions have sympathised with a rise of 2 points, and Rio Tramways bonds are wanted at the improved levels of 87 for the Firsts and 76½ for the Seconds. British Columbia Electric Railway stocks have been little affected by the issue of a preliminary circular to proprietors, who are now officially informed of the municipal competition with which the company is threatened. They are promised further information in due course. Oddly enough, the 4½ per cent. debenture stock has risen 2 points, from which it might appear that the market takes the view that the prior-charge is safer than before. The yield, of course, is good, being nearly 7½ per cent. allowing for accrued interest in the price. Canadian General Electrics at 119 are 2½ higher.

Cable prices mount day by day. The investor is keen upon getting any of the good-class descriptions, and, of the more speculative, West India and Panama continue their giddy advance, at 32s. 6d. showing another jump of 3s. 9d. The First Preference are 5s. up at 8, and the Seconds are equally better at 7. Globe ordinary and preference have recovered more than their dividends. Both Eastern and Western groups have hardened. The same story is repeated amongst manufacturing shares. Telegraph Constructions are £1 up, plus the dividend deducted last week. Callenders have put on another 5s. Those stocks which show no quotable changes are really stronger, because there are many buyers and hardly any sellers. Marconis are quiet, though the Marines at 48s. 9d. have improved a little.

Rubber shares remain firm, and base-metal issues are very steady. Armaments have slightly risen. Iron, coal, and steel issues are amongst the industrials for which there is active demand.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1915.	Dividend 1916.	Price July 17, 1917.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	9	6¼	—	£8 18 6
Charing Cross Ordinary ..	5	5	8½	—	7 2 10
do. do. do. 4½ Pref..	4½	4½	8½	—	5 18 6
Chelsea	4	3	2¾	—	5 4 4
City of London	8	8	12½	+ ⅛	6 8 0
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	11	+ ¼	6 7 3
do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	7	10	5½	—	5 11 7
London Electric	3	3	1	—	Nil
do. do. 6 per cent. Pref.	6	4	8½	—	5 6 8
Metropolitan	3	3	2½	—	6 0 0
do. 4½ per cent. Pref.	4½	4½	8½	+ ¼	7 4 8
St. James' and Pall Mall ..	6	6	6¾	—	6 3 1
South London	5	5	3½	—	7 5 6
South Metropolitan Pref. ..	7	7	20/-	—	7 0 0
Westminster Ordinary	7	7	8¼	—	6 1 9
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	99	+1	6 1 0
do. Def.	33/6	1½	22½	—	6 16 4
Chile Telephone	8	8	7	—	5 14 4
Cuba Sub. Ord.	5	5	8¾	—	5 17 8
Eastern Extension	8	8	14xd	+ ⅛	*5 14 6
Eastern Tel. Ord.	8	8	140xd	—	*5 14 6
Globe Tel. and T. Ord.	7	7	12⅝xd	+ ⅛	*5 9 10
do. Pref.	6	6	10½xd	+ ⅛	5 17 1
Great Northern Tel.	23	24	36	—	6 13 4
Indo-European	13	13	51	—	5 7 5
Marconi	10	10	3½	— 1/32	3 1 6
New York Tel. 4½	4½	4½	99	—	4 11 0
Oriental Telephone Ord. ..	10	10	2¾	+ ⅛	3 12 9
United R. Plate Tel.	8	8	6¾	—	*5 18 6
West India and Pan.	6d.	6d.	1⅜	+ 1/32	1 10 9
Western Telegraph	8	8	14½	+ ⅛	*6 13 4
HOME RAILS.					
Central London, Ord. Assented	4	4	60½	—	6 8 0
Metropolitan	1	1	24	— ¼	4 3 4
do. District	Nil	Nil	15	— ¼	Nil
Underground Electric Ordinary	Nil	Nil	12	—	Nil
do. do. "A" ..	Nil	Nil	5/0	—	Nil
do. do. Income	6	5	84	+ ½	*5 19 1
FOREIGN TRAMS, &c.					
	Dividend 1915.	Dividend 1916.			
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams, First Pref.	5½	5½	21¾	—	7 18 6
do. 2nd Pref. ..	5½	—	2¾	— ⅛	—
do. 5 Deb. ..	5	5	68	—	7 6 6
Brazil Tractions	4	4	50	+2	—
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Ry. Pfcs.	5	5	56½xd	—	8 17 0
do. do. Preferred	Nil	Nil	82½	—	Nil
do. do. Deferred	Nil	Nil	27½	—	Nil
do. do. Deb.	4½	4½	59½	+2	7 3 6
Mexico Trams 5 per cent. Bonds	Nil	Nil	37	—	Nil
do. 6 per cent. Bonds	Nil	Nil	50	—	Nil
Mexican Light Common ..	Nil	Nil	14½	—	Nil
do. Pref.	Nil	Nil	22½	—	Nil
do. 1st Bonds ..	Nil	Nil	80½	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	27½xd	—1/-	5 1 0
British Aluminium Ord. ..	7	10	29/-	+9d.	6 18 0
British Insulated Ord. ..	17½	20	19¼	—	7 15 0
British Westinghouse Pref. ..	7½	7½	2 3/16	+ 1/16	5 17 2
Callenders	20	20	13½	+ ½	7 5 6
do. 5 Pref.	5	5	4¼	+ ⅛	5 17 8
Castner-Kellner	22	22	3 5/16	—	6 10 2
Edison Swan, fully paid ..	—	—	1⅛	—	Nil
do. do. 4 per cent. Deb.	4	4	70½	—	5 13 6
Electric Construction	7½	7½	1⅛	—	8 0 0
Gen. Elec. Pref.	6	6	10	—	6 0 0
do. Ord.	10	10	16½	+½	6 1 3
Henley	25	25	18	—	7 16 8
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	12	12	12½	—	*5 5 0
Telegraph Con.	20	20	28½xd	+1⅛	*6 5 2

*Dividends paid free of income-tax.

MARKET QUOTATIONS.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, July 18th.

CHEMICALS, &c.	Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic .. .. per lb.	1/6	..
a Ammoniac Sal .. .. .. per ton	£75	..
a Ammonia, Muriate (large crystal) ..	£64	..
a Bisulphide of Carbon	£33	..
a Borax	£39	..
a Copper Sulphate	£61 10	..
a Potash, Chlorate .. .. .. per lb.	2/6	..
a ,, Perchlorate	2/-	..
a Shellac .. .. per cwt.	205/-	10/- dec.
a Sulphate of Magnesia .. .. per ton	£18	..
a Sulphur, Sublimed Flowers	£35	..
a ,, Lump	£34	..
a Soda, Chlorate .. .. .. per lb.	10½d.	..
a ,, Crystals .. .. .. per ton	120/-	..
a Sodium Bichromate, casks .. per lb.	..	..
METALS, &c.		
c Brass (rolled metal 2" to 12" basis) per lb.	..	..
c ,, Tubes (solid drawn)	..	..
c ,, Wire, basis	..	..
c Copper Tubes (solid drawn)	1/8½ to 1/8¾	..
g ,, Bars (best selected) .. per ton	£165	..
g ,, Sheet	£165	..
g ,, Rod	£165	..
d ,, (Electrolytic) Bars	£142	..
d ,, ,, Sheets	£167	..
d ,, ,, Wire Rods ..	£150	..
d ,, ,, H.C. Wire per lb.	1/5½	..
f Ebonite Rod	3/-	..
f ,, Sheet	2/6	..
n German Silver Wire	2/3	..
h Gutta-percha, fine	6/10	..
h India-rubber, Para fine	3/2	2d. inc.
i Iron Pig (Cleveland warrants) .. per ton	Nom.	..
l ,, Wire, galv. No. 8, P.O. qual. ..	£42	..
g Lead, English Pig	..	..
g Mercury .. .. per bot.	Nom.	..
a Mica (in original cases) small .. per lb.	6d. to 3/-	..
a ,, ,, ,, medium ..	3/6 to 6/-	..
a ,, ,, ,, large	7/6 to 14/- & up.	..
d Silicium Bronze Wire .. .. per lb.	1/0½	..
r Steel, Magnet, in bars .. .. per ton	..	..
g Tin, Block (English)	..	..
n ,, Wire, Nos. 1 to 16 .. .. per lb.	3/6	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

The British Association.—With further reference to the B.A. arrangements for this year and next, we read in *Nature* that in view of the cancellation of the annual meeting of the British Association, it has been necessary to make special arrangements for carrying on the Association's current work. Meetings of the Organising Committees of the various Sections, the delegates of corresponding Societies, the Committee of Recommendations, and the General Committee have, therefore, been held. It has been decided to continue Sir Arthur Evans in the presidency for another year, while the Hon. Sir C. A. Parsons, who would have presided over this year's meeting, will do so at the meeting which, it is hoped, will take place as arranged at Cardiff next year. Bournemouth has repeated its invitation, which has been accepted for 1919. Grants amounting to £286 were made in aid of such researches as it was considered essential to carry on, having regard to present conditions.

Resuscitation after Electric Shock.—In the *Electrical World* of May 5th, Mr. W. P. Strickland cites another case in which a man who had received a shock on a 2,200-volt circuit was brought back to consciousness without special apparatus with the aid of mechanical shocks. The man was on the top of a pole when he received the shock; the lines were cut, and the victim was lowered to the ground, being purposely allowed to *drop* the last 3 ft. His body was then lifted by the heels (his head resting on the ground) and dropped. While his clothes were being loosened and his tongue drawn forward, the soles of his feet were struck vigorously with anything that came handy, and this treatment was continued during the application of the Schaeffer method of artificial respiration. Recovery was complete. In another case a man was restored to consciousness by falling from a pole.

Canada's Coal Supply.—The Canadian Fuel Controller has been given authority to investigate the amount of fuel stocks on hand, and to arrange for an equitable distribution of the supply. Coal production will be stimulated, and an effort made to establish large stocks inland before water transportation closes for the season.—*Times.*

A Cynical Conundrum.—A "Victim of Many Reconstructions" propounds the following:—"What's the difference between reconstruction and liquidation?" His suggested reply is: "Well, you sometimes get something out of the latter!"—*Financial Times.*

THE PSYCHOLOGY OF POWER-HOUSE SHIFT WORK: AN EX-SHIFTMAN'S REFLECTIONS.

By A. ARNOLD.

Much attention has been given at sundry times to the conditions under which men are capable of producing maximum useful work, particularly in the case of manual labour, but little note seems to have been taken of the modifications necessarily involved when provision must be made for continuous running, and hence relays of labour.

The economic results accruing from semi-"Taylorism," applied with discretion to manual and repetitive work are, doubtless, considerable; but in the average generating station—with which the writer is now concerned—there is little scope for such application, except, perhaps, to a limited extent in connection with coal and ash handling. "Taylorism," or scientific management, does not appear to have been intended for use with skilled workers, nor, indeed, is it applicable to duties involving the exercise of judgment and initiative, although the principle (of avoiding circumlocution and needless expenditure of energy, by direct methods) might well form the foundation of a course of mental training for such workers, and this would doubtless result in quicker and sounder decisions.

Power-station work is often jeered at by persons of restricted experience as being "too dull for words," a job comprised of starting up and shutting down sets and boilers to meet the requirements of the load and otherwise simply watching the clock go round—wholly mechanical, methodical, and prosaic, lacking variety, interest, or scope. Under some conditions, portions of this indictment may be substantiated, but few engineers with station experience would admit that it exhibits anything like a true picture as a whole. Practically all posts in a central station—from greaser to manager—call for more or less display of initiative and judgment, unlike factory work in general; there, quickness and manual dexterity count for more than brains, except in the higher positions. Further, the staff of a power house is necessarily on shift work, again excluding the management and higher officials, and its treatment should also be modified in view of that fact. It is fallacious to imagine that because any given person on shift work averages only a number of hours on duty similar to the total of a day-working artisan, he is therefore on an equality with the latter in respect of energy-output value, even if the actual work done in the two cases be identical.

It has been often demonstrated that "seven-days-a-week" labour is inefficient, in the sense that it involves expenditure of energy out of proportion to the increased work performed, and similarly the psychological tendency of night work is to decrease one's personal energy-output value. This is also the case in regard to long spells of duty, and is cumulative; it is usually noticeable even in ordinary day work after about six hours' duty without distinct relaxation of both mental and physical stress. At night this depreciation becomes marked in normal persons after about four hours' application, even when the "previous history" of the observed individuals is known to be good, with respect to reasonable rest and sleep; hence the interests of the undertaking, no less than those of the watch-keepers themselves, require that the duties of night shift should be kept down to the essential minimum. The policy of a few managers to set aside many detail jobs for the night staff is a short-sighted one under the present system, and is as fallacious as the execution of the innocent Admiral "pour encourager les autres."

The psychological and physiological effects due to the periodic change of shift at week-ends are frequently ignored, but their reality is unquestionable. From social and humanitarian points of view such periodic changes are imperative; also the utilitarian advantage of giving experience in all duties to each individual demands it, in order to produce a strong staff and one able to meet possible depletion by illness or disaffection. Nevertheless, physiologically these changes do harm; they disturb the health, and hence deteriorate the coolness and emergency value of everyone affected by them. The psychological effect is not so simple. Changes are beneficial, in so far as they prevent stagnation (or more properly, "vegetation," to pervert a word), and they promote interest and concentration, and sometimes competition and emulation; in so far, however, as there is usually a favourite and also a very strongly disliked shift, the anticipation of the approach of the latter, and the reflexive, but probably unconscious relaxation of effort when it arrives, is only partly off-set by the good effects of the expectation of the better shift to come.

Power station shift systems vary but slightly in the British Isles, and the variations are usually of local origin. Anyone who has attempted to alter a shift list (or "watch-bill," in sea parlance) so as to obtain improved conditions without bringing in extra assistance, knows that inevitably the existing scheme is found to be the best under the prevailing conditions, except possibly in some very minor detail; this is only to be expected, as the present system is a product of gradual evolution. No further big improvement can be expected without very drastic alterations, but probably the time is now ripe for such.

A semi-ideal system of shifts might be similar to that in vogue at sea—a short watch of, say, four hours, followed by an interval of at least eight hours and preferably longer; but the interim should be entirely free, and not, as is usual, partly occupied by concern for some specialised department. This system, with, say, a 48-hour break every fortnight, would be physiologically as nearly healthy as possible, having regard to the necessity for a periodic change of shift. It would be, however, quite impossible ashore, on account of the time taken in the journey to and from the works, which would, in effect, be just doubled as compared with the existing eight-hour shifts, and, further, it would lead to times of starting and leaving work which would not fit in at all with the general conventional scheme of things.

The system at present in operation suffers from obvious disadvantages. Night shift is longer than is physiologically desirable or even economically defensible, particularly as in most cases the preparation for, and the picking up of, the morning load comes upon the latter end of this shift, just when vitality and energy are at their minimum. Further, as watch-keepers are but human, it must not be supposed that the beginning of this shift coincides with the commencement of the individual's day; it seldom or never does. All the world takes its pleasure and social recreation in the evening hours, and so the increased activities demanded in the latter hours of the night shift find the *personnel* more fit for bed than for a display of the brilliance to be expected of "the embodiment of all that is best in British engineering manhood."

The week-end system is also faulty. It is recognised even by the worst type of official that a regular break, say every three weeks or a month, is essential to every individual, that he may maintain his sanity, fulfil social obligations, and obtain necessary change and rest. In probably 95 per cent. of British power stations there are no reliefs in regular routine—a state of affairs which can only be excused during war time, but which is now only a little worse than prior to it. As a consequence, for a person to obtain this minimum recreative opportunity he must pay for it (in hours worked) during subsequent week ends, while his colleagues enjoy by rotation their respite, also duly paid for. Now, in all engineering works there are repair jobs and alterations which can only be carried out at times of light load; these are done at week-ends, and are accomplished by, or under the direct supervision and responsibility of, an engineer who is working 12-hour or longer shifts after a normally fatiguing week—not a very fair arrangement, either to him or his work. This applies more particularly to the engineers-in-charge of shifts; but in a general way, long hours are also demoralising to all engaged in week-end work, for they give some foundation for the "long-suffering martyr" feeling so easily aroused amongst those working unusual hours.

In cases of illness it is usual under the present system for the two remaining men of the affected grade to work 12-hour shifts. Only a few longer-sighted engineers have arranged their staffs so that reliefs can be found, and still

fewer have carried out the scheme in its entirety, so as to include chargemen as well as stokers. Twelve-hour shifts under modern conditions are demoralising—physiologically, psychologically, and economically; the undertaking which allows them is laying up big possibilities of trouble. Practically all preventible accidents are the result of overstrained physique or mentality, both of which are indubitably brought about by long shifts amongst other causes, hence the danger. It is beginning to be realised, too, that men are not mere machines, and, further, that to obtain the best results, employers must be at least as solicitous for their welfare and decent treatment as they are as to the precise minimum remuneration which can be offered. In another decade it is possible that an employer permitting 12-hour shifts will be liable to salutary penalties.

In view of these matters, it is obvious that at least four men of each grade should be employed, except where it may be possible to provide "double-utility" relief men. The latter, however, although usually only the most intelligent qualify, are often very averse to being employed thus, and, in the lower ratings at least, their colleagues are apt to resent it also. Whether this is but a passing phase remains to be seen.

The question of expense will, of course, be raised in opposition to this suggested increase of staff. Yet, if the extra wage bill were translated into terms of pence per unit generated or percentage decrease in available profits, it would be seen to be almost infinitesimally small as compared with the increased efficiency of the staff employed and their consequently enhanced value.

It is difficult to foresee at all clearly the position of electrical undertakings, after the conclusion of peace, with regard to staff. The relaxation of military authority, and the apparent cessation of the necessity for self-discipline, will greatly affect the labour market. Skilled men will only be available on their own terms, and they will not willingly enter shift work. Although the present staffs of stations throughout the country have shown splendid loyalty both to their employers and their country, by sticking to their posts when khaki was immeasurably more popular, they are now thoroughly unsettled, and a "General Post" is quite certain when the present restrictions as to movements are withdrawn. Their loyalty to their employers deserves emphasis, in the writer's opinion, and was well shown by the apparent collapse of the A.E.S.E. when that body began to meditate militant tactics.

Now, therefore, is the employers' opportunity to formulate and publish schemes whereby the present anomalies of the shift system may be smoothed out—eradicated they can never be. In the long run, the employers will be gainers by taking the initiative in this matter, and they will attract the better type of men, and form stable, loyal staffs.

The future commercial greatness of this country will be greatly aided by adequate, cheap and reliable supplies of electrical power, and the reliability depends very largely upon the staff engaged and their conditions of employment, having in view their peculiarly trying hours and the onerous duties and responsibilities devolving upon them.

TRADE STATISTICS OF SOUTH AFRICA.

THE following statement, showing the imports of electrical and similar goods into the Union of South Africa during the year 1916, has been taken from the recently-issued official trade statistics. The figures for 1915 are added for purposes of comparison, and notes of any increases or decreases are given:—

	1915. £	1916. £	Inc. or dec. £
Brass manufactures.—			
From Great Britain ...	19,000	24,000	+ 5,000
,, United States ...	—	2,000	+ 2,000
,, Other countries ...	2,000	2,000*	—
Total	21,000	28,000	+ 7,000
*Mainly India.			
Copper, plate and sheet.—			
From Great Britain ...	4,000	4,000	—
Copper manufactures.—			
From Great Britain ...	3,000	3,000	—
,, United States ...	—	1,000	+ 1,000
Total	3,000	4,000	+ 1,000
Electrical cable and wire.—			
From Great Britain ...	102,000	228,000	+ 126,000
,, Italy	1,000	1,000	—
,, United States ...	8,000	5,000	- 3,000
,, Other countries ...	1,000	3,000*	+ 2,000
Total	112,000	237,000	+ 125,000
*Holland £3,000.			
Electrical fittings, including posts.—			
From Great Britain ...	125,000	200,000	+ 75,000
,, Germany	3,000	—	- 3,000
,, Holland	11,000	22,000	+ 11,000
,, United States ...	37,000	62,000	+ 25,000
,, Other countries ...	6,000	14,000*	+ 8,000
Total	182,000	298,000	+ 116,000
*Denmark £4,000.			
Lamps and lampware.—			
From Great Britain ...	15,000	28,000	+ 13,000
,, Germany	1,000	—	- 1,000
,, United States ...	12,000	19,000	+ 7,000
,, Sweden	3,000	17,000	+ 14,000
,, Other countries ...	1,000	2,000	+ 1,000
Total	32,000	66,000	+ 34,000
Electrical machinery.—			
From Great Britain ...	110,000	112,000	+ 2,000
,, Germany	4,000	—	- 4,000
,, United States ...	59,000	63,000	+ 4,000
,, Other countries ...	5,000	5,000*	—
Total	178,000	180,000	+ 2,000
*Mainly Sweden.			
Cranes, elevators, and lifts.—			
From Great Britain ...	18,000	17,000	- 1,000
,, United States ...	2,000	2,000	—
Total	20,000	19,000	- 1,000
Mining machinery.—			
From Great Britain ...	368,000	473,000	+ 105,000
,, Germany	2,000	—	- 2,000
,, United States ...	240,000	253,000	+ 13,000
,, Other countries ...	3,000	3,000*	—
Total	613,000	729,000	+ 116,000
*Sweden £2,000.			
Machinery not specially mentioned (other than agricultural, manufacturing, &c.).—			
From Great Britain ...	201,000	256,000	+ 55,000
,, Germany	5,000	2,000	- 3,000
,, United States ...	43,000	59,000	+ 16,000
,, Canada	3,000	6,000	+ 3,000
,, Other countries ...	3,000	5,000	+ 2,000
Total	255,000	328,000	+ 73,000
Telegraph and telephone material.—			
From Great Britain ...	8,000	8,000	—
,, Sweden	2,000	2,000	—
,, United States ...	1,000	—	- 1,000
,, Other countries ...	—	1,000	+ 1,000
Total	11,000	11,000	—
Tramway rolling-stock.—			
From Great Britain ...	21,000	10,000	- 11,000
,, United States ...	4,000	2,000	- 2,000
,, Other countries ...	—	1,000	+ 1,000
Total	25,000	13,000	- 12,000
Other tramway materials.—			
From Great Britain ...	5,000	2,000	- 3,000
,, United States ...	2,000	2,000	—
,, Other countries ...	1,000	1,000	—
Total	8,000	5,000	- 3,000

In addition to the above the following goods were imported as "Government Stores":—

Brassware.—			
From United Kingdom ...	1,500	4,000	+ 2,500
Copper, plate and sheet.—			
From United Kingdom ...	14,000	6,000	- 8,000

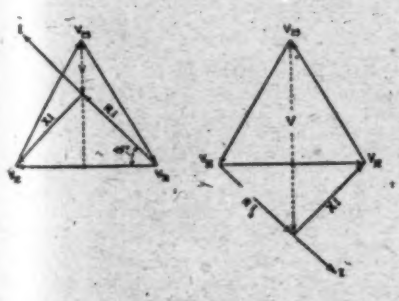
	1915. £	1916. £	Inc. or dec. £
Electrical cable and wire.—			
From United Kingdom ...	18,000	22,000	+ 4,000
„ United States ...	1,000	—	− 1,000
Total	19,000	22,000	+ 3,000
Electric fittings.—			
From United Kingdom ...	14,000	13,000	− 1,000
„ Other countries ...	1,000	1,000	—
Total	15,000	14,000	− 1,000
Lampware.—			
From United Kingdom ...	1,000	2,000	+ 1,000
Cranes and elevators.—			
From United Kingdom ...	8,000	—	− 8,000
Electrical machinery.—			
From United Kingdom ...	3,000	5,000	+ 2,000
Other machinery.—			
From United Kingdom ...	20,000	7,500	− 12,500
„ Other countries ...	1,000	4,500*	+ 3,500
Total	21,000	12,000	− 9,000
Telegraph and telephone material.—			
From United Kingdom ...	30,000	21,000	− 9,000
„ Sweden	5,000	5,000	—
„ Other countries ...	1,000	—	− 1,000
Total	36,000	26,000	− 10,000

*United States mainly.

DETERMINING PHASE ROTATION.*

By W. V. LYON.

For determining the phase rotation in a three-phase circuit, that is, to ascertain whether or not the line voltage between mains 1 and 2 leads or lags the voltage between mains 2 and 3, the writer has found the scheme shown in the accompanying illustrations useful and convenient. It consists of a non-inductive resister and a low-resistance reacter of the same ohm value connected in series between two of the mains. The magnitude of the voltage between the third main and the junction of these two units indicates the phase rotation. Mark the mains 1, 2, and 3 as in fig. 3. Connect the free terminal of the resister to main 1 and the free terminal of the reacter to main 2. Measure the voltage from their junction to main 3.



Figs. 1 and 2.—Vector Relations of Voltage for Leading and Lagging Conditions.

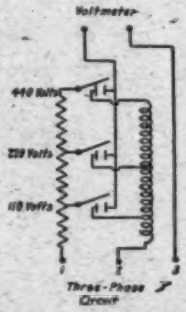


Fig. 3.—Connections of Resister, Reacter and Voltmeter.

If this voltage is approximately 37 per cent. of the line voltage, the voltage between mains 1 and 2 leads the voltage between mains 2 and 3. If the voltage is approximately 137 per cent. of the line voltage, however, the voltage between mains 1 and 2 lags the voltage between mains 2 and 3.

The proof of this fact is simple. Refer to figs. 1 and 2. Assume that the line voltages are equal. The interior angles of the voltage triangles are then 60°. Any ordinary unbalancing of the line voltages would affect the voltmeter reading but little. The current should be at least ten times as much as the voltmeter takes on full scale deflection. If this be the case the voltmeter will read not more than 2 per cent. less than the stated values. In the proof it is assumed that the voltmeter current is negligibly small.

Let V_{12} lead V_{23} as shown in fig. 1. If the resister and reacter have the same resistance value in ohms, the current will lag the voltage from 1 to 2 by 45°. The voltmeter reading, v, will be—

$$v = (0{\cdot}866 - 0{\cdot}50) \times \text{line voltage}$$
$$= 0{\cdot}37 \times \text{line voltage}.$$

If V_{12} lags V_{23} as shown in fig. 2, the voltmeter reading is—

$$v = (0{\cdot}866 + 0{\cdot}50) \times \text{line voltage}$$
$$= 1{\cdot}37 \times \text{line voltage}.$$

In order that the device may be used on circuits of different voltages switches should be provided as shown in fig. 3. For example, when it is to be used on a 220-volt circuit the switch marked 220 volts should be closed and the other two left open. By properly choosing the ohm values of the units, the current may be kept constant and the same accuracy obtained at the different voltages without excessive heating loss.

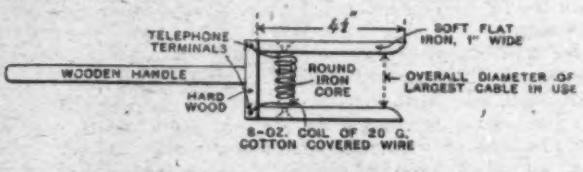
* From the *Electrical World*.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Induction Methods of Fault Localisation.

With reference to the letter from "North Staffs." in your last issue, to pick out a faulty cable at draw boxes, the triangle is more conveniently replaced with a fork, in accordance with the accompanying sketch.



A switch in the telephone circuit, by making and breaking the current to the receiver, more readily distinguishes the sound produced by the induction coil from any extraneous noises.

H. E. Blake.

Eastbourne, *July 7th*, 1917.

A Revelation Concerning the Ways of Reviewers.

In a recent review of a book in an electrical journal that shall be nameless, the reviewer apologises for the tardiness thereof with the plea that "he got interested in it, so that instead of reading merely the introduction and contents pages and basing his review on these, he read it through and forgot he was a mere reviewer."

These remarks, quite obviously made in all seriousness, will be received with mixed feelings by those whose misfortune it is to be authors, by publishers, and by a large body of readers who look for enlightenment and guidance in reviews.

Comment seems hopeless, unless other people will take up the cudgels.

W. Perren Maycock.

West Norwood, S.E. 27, *July 14th*, 1917.

[We fear our correspondent's sense of humour has been caught napping in this instance. The remarks in question, to our mind, we "quite obviously" facetious, and the reviewer happens to our knowledge to be conscientious to the last degree, one who is more likely to read the chapter headings, index, and advertisements in addition to the text than to follow the practice to which he playfully alludes. Moreover, he has made a special study of the subject of the work in question—that is why he was asked to review it.—Eds. Elec. Rev.]

Water-Power Proposals.

Your remarks on the development of water power in your issue of the 6th inst. are most opportune, and I trust now that the matter has been raised that the existence of available power will be realised by an authority that will be competent to carry out the necessary schemes for its development.

I am a native of North Wales, and am acquainted with many suitable sites which deserve attention. My playmate when a child was a stream that ran through my father's farm, and a noisy Scotch turbine provided daily enjoyment to me as it operated the barn and dairy machinery. The hero of those days to me was the man who had charge of that rough but serviceable plant.

In later years my father moved to a larger farm—a noted dry one. I was at that time but a youngster, but great was my joy when I realised that one of his first objects was to provide an irrigation system for the whole farm, together with two turbines for power purposes. To go with him on levelling and surveying expeditions, and laying out water courses, was the greatest pleasure that could be experienced. Never shall I forget the day when the water was turned on to the turbine for the first time.

Unfortunately, my father did not combine his knowledge of engineering and hydraulics with that of the law, the result being that he was legally involved over the question of riparian rights. He lost his case from the legal point of view, but his engineering abilities came to his aid, and he has been able

to maintain the supply to the present day. The installation to-day, after 27 years' use, stands as an example of practical engineering and a monument to the properties of the laws of this country.

For the last 15 years one of the turbines has been coupled to a generator, this being the first electric lighting plant installed in the district.

Since that time I have been interested in several small hydro-electric plants, having made a hobby of that branch of engineering, and devoting my yearly vacations to exploring possible power schemes for farm and village supply.

I consider Mr. Britton's opportunity a magnificent one, and I sincerely hope he will be able to carry his ideas to a successful issue.

The Dee, to which he intends devoting special attention, is but one instance. The Clwyd and Conway in their upper reaches have scores of localities where plants of from 20 to 200 KW. could be installed. The rivers of Snowdonia, with their high falls, are rich in possibilities. Blaenau Festiniog is an instance of wasted power; in fact, the waste is to be seen on every hand throughout the Principality.

A source of power which has appealed to me is that of relief stations on the pipe lines of our town supplies, and the surplus waters at our reservoirs. The Vyrnwy and Rhayadr works are instances. At both these reservoirs a considerable quantity of compensation water is allowed to flow, and very large volumes flow over the sills during the winter months. Instead of allowing this to run to waste, why not allow it to flow along the pipe line to the utmost capacity, and at its highest load factor, and utilise it at suitable points along the route? Why not allow Mr. Britton, for instance, to tap the Vyrnwy line at a point near Chester, utilising surplus water at that point, and at the same time augmenting the supply to his existing station lower down? In the case of the Rhayadr works the same applies, the supply being given to small towns and villages *en route*.

Another instance is the new Birkenhead waterworks. In this case turbines could be fixed at such places as Llanfihangel, Clawdd Newydd, and Ruthin. Again, after crossing the Clwydian Range, if any further supply is available it could be utilised on either side of the Dee, as found necessary.

The question arises as to how these developments are to be carried out. I doubt if a private company can be formed to undertake the work, owing to the hostility of riparian owners and holders of sporting rights. The alternative is for the Government to form a Department of National Power Supply to take charge of all our water power, and to control its development. This could be extended to the smallest plants, even where electricity is not generated. Small installations could be installed on hire-purchase systems, and in the case of larger ones licences could be granted to companies and local authorities to develop them under national control.

In this way encouragement would be given to farmers to extend the use of power on their farms, it would lessen the drudgery of farm work, and generally increase the yield of our land. Our villages would be brightened, not only from the illumination point of view, but from a social standpoint. Industries requiring small power would be established along our countryside, and the cry of "back to the land" would at last become practical.

The North Wales Power Co. has done pioneer work in this direction, but its progress has not been very marked. I am not acquainted with the conditions responsible for its apparent failure to compete with the steam stations at Carnarvon and along the North Wales coast, but it most probably can be accounted for by wayleave and other difficulties, together with, most probably, a certain amount of parochial jealousy.

All these difficulties would be overcome by a national system possessing compulsory powers of expropriation.

Thomas Smith.

Wolverhampton, *July 10th*, 1917.

The Salaries of Central-Station Officials.

The table of average salaries of central-station officials given in this week's REVIEW is particularly interesting in the poor comparison they make with the salaries of leading officials in other professions. In nearly all municipalities the town clerk receives quite twice the salary of the electrical engineer. In these days this is surely absurd. In the Army the engineers have long been the most highly paid branch, and in the majority of circumstances the R.E. officer takes command. In these days, when cheap and reliable power is the life-blood of a nation, it is surely time that the electrical engineer topped the lawyer in salary. The achievement of this is also, I should like to suggest, an engineering problem (in an introductory note by Dr. Thurston to Rowan's "Practical Physics of the Steam Boiler," the following passage occurs: "The engineer, it will be seen, is also a high order of financier"). I wonder if it is high finance to suggest that, as the chief's salary must always bear a certain ratio to his assistants', his own may be automatically "boosted" by boosting his assistants'?

Assistant.

[We cannot make use of the information forwarded by "Rex" unless he sends us his name and address.—EDS.]

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

9,501. "Sparking plugs for internal-combustion engines, and method of manufacture." R. HOWARTH. July 3rd.

9,521. "Means for connecting high-tension leads to sparking plugs." V. PERRETT. July 3rd.

9,552. "Electric accumulators." H. HARROP. July 3rd.

9,553. "Active material in accumulator plates." H. LEITNER. July 3rd.

9,554. "Supports for accumulator plates." H. LEITNER. July 3rd.

9,558. "Electrically-operated riveting, pressing, stamping, &c., machines." E. ADAMSON. July 3rd.

9,573. "Separators or non-conducting supports for accumulator plates." H. LEITNER. July 3rd.

9,579. "Electric lanterns for hand signalling." H. BURGE & S. D. WHITE. July 3rd.

9,584. "Electric furnaces and method of working same." CRITTALL MANUFACTURING Co. & H. S. PRIMROSE. July 3rd.

9,585. "Interrupters." MARCONI'S WIRELESS TELEGRAPH Co. & W. PLATT. July 3rd.

9,587. "Electric condensers." F. R. SIMMS & SIMMS MOTOR UNITS, LTD. July 3rd.

9,595. "Electro-magnetic apparatus." M. LATOUR. July 3rd.

9,631. "Electrolytic electricity meters." BASTIAN METER Co. & A. E. SALISBURY. July 4th.

9,675. "Dynamo-electric machines." H. F. BROWN & VICKERS, LTD. July 4th.

9,724. "Voltage regulators." BRITISH THOMSON-HOUSTON Co. (General Electric Co., U.S.A.). July 5th.

9,747. "Electric fuses." E. S. CONRADI & L. NEWITT. July 5th.

9,781. "Field telegraph signalling, &c., apparatus." F. FITTON. July 6th.

9,784. "Telephones." E. A PETITHORY. July 6th.

9,801. "Electric switches." H. H. BERRY & W. J. MARKHAM. July 6th.

9,811, 9,816. "Multipolar magnetos for electric ignition systems." BOSCH MAGNETO Co. & W. J. MELLERSH JACKSON. July 6th.

9,855. "Spark discharges producing impulse excitation and high-frequency sparks." A. KOWALSKI. July 7th. (Switzerland, July 25th, 1916.)

PUBLISHED SPECIFICATIONS.

1916.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

5,447. PHOTOGRAPHIC METHOD OF PRODUCING SOUND RECORDS AND MEANS FOR UTILISING SAME FOR PRODUCTION OF MAGNETIC RECORDS. H. C. Bullis. April 13th, 1916. (107,035.)

8,056. ELECTRICAL WATER HEATERS. J. F. Barr. June 7th, 1916. (Cognate application, 13,564/16.) (107,038.)

8,178. TELEPHONY. Relay Automatic Telephone Co. & H. J. Herink. June 9th, 1916. (107,041.)

8,179. TELEPHONE SYSTEMS. Relay Automatic Telephone Co. & H. J. Herink. June 9th, 1916. (107,042.)

8,245. ELECTRIC IGNITION OR SPARKING ARRANGEMENTS. Siemens Bros. and Co. & H. W. F. Ireland. June 10th, 1916. (107,048.)

8,305. TELEPHONE TRANSMITTER. S. C. Porter. June 12th, 1915. (100,689.)

8,457. MAGNETO ELECTRIC MACHINES. A. E. Bennett. June 15th, 1916. (107,062.)

8,474. STEAM-POWER PLANTS, PARTICULARLY FOR USE IN ELECTRIC GENERATING SYSTEMS. J. C. Ruths. June 14th, 1915. (100,693.)

8,733. ELECTRIC CABLES. C. J. Beaver & E. A. Claremont. June 21st, 1916. (107,073.)

8,810. MINERS' ELECTRIC SAFETY LAMPS. O. Oldham. June 22nd, 1916. (107,074.)

8,811. ELECTRIC BATTERY LAMPS. N. Kribs. June 22nd, 1916. (107,075.)

9,766. REGULATORS FOR POLYPHASE TRANSMISSION SYSTEMS. British Thomson-Houston Co. (General Electric Co., U.S.A.). July 11th, 1916. (Cognate application, 9,812/16.) (107,093.)

10,182. MEANS FOR DIFFERENTIALLY METERING ELECTRICITY FOR LIGHTING AND HEATING PURPOSES. L. Birks & J. R. Templin. March 2nd, 1916. (104,498.)

11,043. ELECTRIC MOTOR CONTROL. British Thomson-Houston Co. (General Electric Co., U.S.A.). August 4th, 1916. (107,106.)

12,685. ELECTRIC INSULATING MATERIAL RESEMBLING VULCANITE. T. S. Chivers and C. Marter. September 7th, 1916. (107,122.)

16,514. TIMING IN IGNITION DYNAMOS. C. T. Mason. June 19th, 1915. (102,267.)

18,194. IGNITION MAGNETOS FOR INTERNAL-COMBUSTION ENGINES. Abingdon-Ecco, Ltd., & G. B. Bianco. December 19th, 1916. (106,954.)

18,374. ELECTRO-PNEUMATIC BRAKES FOR RAILWAY VEHICLES. E. H. Dewson. June 1st, 1916. (106,813.)

1917.

1,279. AUTOMATIC SWITCHING DEVICES FOR THERMIC TELEPHONES. B. E. D. Kilburn (Naamloeze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij). January 25th, 1917. (106,963.)

2,191. AUTOMATIC ELECTRIC CIRCUIT BREAKERS. Switchgear & Cowans and E. D. Rodway. February 14th, 1917. (106,971.)

2,912. MERCURY RECTIFIER DISTRIBUTING SYSTEMS. British Westinghouse Electric & Manufacturing Co. (Westinghouse Electric Manufacturing Co., U.S.A.). February 27th, 1917. (106,973.)

5,401. TRANSFORMERS FOR ALTERNATING ELECTRIC CURRENTS. O. Loras. June 9th, 1916. (106,986.)

Accident.—On Friday at the Yorkshire Electric Power Co.'s works at Thornhill, two workmen aged 61 and 59 respectively, in the employ of Messrs. Firth & Co., of Burton-on-Trent, who are engaged upon the contractor's work in connection with the extension scheme at the power station, came into contact with a live wire and received a shock while working at a crane. Both were in a critical condition, suffering from burns on the feet and hands.